



*guardians of drinking water quality*

**INTERIM GUIDANCE**

**ON THE**

**WATER SUPPLY (WATER QUALITY) REGULATIONS 2000  
(ENGLAND)**

**AND THE**

**WATER SUPPLY (WATER QUALITY) REGULATIONS 2001  
(WALES)**

Drinking Water Inspectorate

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## **INTRODUCTION**

1 This document provides guidance on the implementation of The Water Supply (Water Quality) Regulations 2000 (SI 3184) and The Water Supply (Water Quality) (Amendment) Regulations 2001 (SI 2885) which apply to water companies whose areas of supply are wholly or mainly in England and The Water Supply (Water Quality) Regulations 2001 (SI 3991) which apply to water companies whose areas of supply are wholly or mainly in Wales. Unless otherwise specified, reference within this document to "the Regulations" means the Water Supply (Water Quality) Regulations 2000, The Water Supply (Water Quality) (Amendment) Regulations 2001 and the Water Supply (Water Quality) Regulations 2001. In line with common practice, water undertakers are referred to as water companies throughout this Guidance.

2 The Drinking Water Inspectorate (DWI) exercises the powers and duties of the Secretary of State for Environment, Food and Rural Affairs and the National Assembly for Wales. When there are references to DWI in the Guidance they mean on behalf of the Secretary of State and National Assembly for Wales. References to the Secretary of State also include reference to the National Assembly for Wales.

3 The Guidance comes into effect in line with the coming into force of the various regulations:

Guidance on regulations 2,27,28,29,40 and 41	1 January 2001 (England) 1 January 2002 (Wales)
Guidance on regulations 3 and 42	1 June 2003
Guidance on regulations 4,17 to 24, 30(4), 30(5) and 43(2)	25 December 2003
Guidance on all other regulations	1 January 2004

4 This is the first edition of the Guidance. It does not purport to offer any authoritative interpretation of the Regulations. It is recognised that it may contain omissions and that some advice will need to be modified or updated as more experience is gained with implementing the new Regulations or further guidance is published by the European Commission. DWI welcomes comments on all aspects of the Guidance. The master copy of the Guidance document has been placed on the Drinking Water Inspectorate website (<http://www.dwi.gov.uk>) and only that version will receive any periodic updates. Water companies will be notified of any changes to the Guidance by e-mail.

## **Regulatory Framework**

5 The following provide the regulatory framework for public drinking water supplies in England and Wales.

- Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption (European Drinking Water Directive) – sets standards for drinking water quality
- The Water Industry Act 1991 (the Act) – the primary legislation which enables Regulations to be made
- The Water Supply (Water Quality) Regulations 2000 (SI 3184) - apply to water companies whose areas of supply are wholly or mainly in England

- The Water Supply (Water Quality) (Amendment) Regulations 2001 (SI 2885) – amend the 2000 Regulations and apply to water companies whose areas of supply are wholly or mainly in England
- The Water Supply (Water Quality) Regulations 2001 (SI 3991) which apply to water companies whose areas of supply are wholly or mainly in Wales.
- The Water Undertakers (Information) Direction 1998 – made under the Act, specifies the format and timing of water companies' provision of information
- The Water Undertakers (Information) Direction 2003 – made under the Act, specifies the format and timing of water companies' provision of information - draft in preparation
- The Food Safety (General Food Hygiene) Regulations 1995 – transpose the Drinking Water Directive with respect to water used for food production

## **6 Associated Regulations and Guidance documents**

- The Surface Waters (Abstraction for Drinking Water) (Classification) Regulations 1996 (SI 3001)
- The Water Supply (Water Fittings) Regulations 1999 (SI 1148)
- Guidance on the Water Supply (Water Fittings) Regulations 1999
- The Drinking Water (Undertakings) (England and Wales) Regulations 2000 (SI 1297)
- The Private Water Supplies Regulations 1991 (SI 2790)
- Private Water Supplies Circular 24/91 (former Department of the Environment) and Circular 68/91 (former Welsh Office)
- The Natural Mineral Water, Spring Water and Bottled Drinking Water Regulations 1999 (SI 1540) and The Natural Mineral Water, Spring Water and Bottled Water (Amendment) (England) Regulations 2003 (SI 666)
- The Microbiology of Drinking Water (2002) in the series 'Methods for the Examination of Water and Associated Materials' published by the Standing Committee of Analysts.
- Principles of Water Supply Hygiene and Technical Guidance Notes (Water UK 1998)
- Guide to the Microbiological Implications of Emergencies in Water Services (Water Authorities' Association 1985)
- 'General Principles of Sampling and Accuracy of Analytical Results' in the series 'Methods for the Examination of Water and Associated Materials' published by the Standing Committee of Analysts.
- Standard Operating Protocol for the Monitoring of *Cryptosporidium* Oocysts in Treated Water Supplies - Part 1 Sampling and Transportation of Samples (Revision June 2003)

- Standard Operating Protocol for the Monitoring of *Cryptosporidium* Oocysts in Treated Water Supplies - Part 2 Laboratory and Analytical Procedures (Revision July 2003)
- DWI Information Letters on *Cryptosporidium*: 10/1999, 4/2000, 10/2000, 13/2000, 28/2000, 8/2001 and 12/2002.
- DWI Information Letters on lead: 12/2000, 3/2001.
- DWI Information Letters on radioactivity: 19/2000, 1/2001.
- Asbestos and drinking water - former Department of the Environment / Welsh Office letter dated 20 February 1986 to Chief Executives of Water Authorities in England and Wales (DoE ref: WS/602/78, Welsh Office ref: WEP/1274/1).
- Guidelines for Calibration in Laboratories, available on the DWI web site ([www.dwi.gov.uk](http://www.dwi.gov.uk)).

#### **Definition of health authority**

7 Where this Guidance refers to a “health authority” this is defined as shown below.

##### **For water supplied within England:**

- (i) the relevant Consultant(s) in Communicable Disease in the Health Protection Agency; and
- (ii) the Director of Public Health for the relevant Primary Care Trust(s).

##### **For water supplied within Wales:**

- (i) the relevant Consultant(s) in Communicable Disease in the National Public Health Service; and
- (ii) the Director of Public Health for the relevant Local Health Board(s).

8 Water companies may enter into alternative local reporting arrangements with health authorities with the written agreement of the parties identified above. Such arrangements should be reviewed regularly.

## PART I

### Regulation 2 - Interpretation

#### Definitions – Reg 2(1) meaning of relevant metabolites

1.1 The Regulations set the following standards for pesticides and related products:

- |                    |           |
|--------------------|-----------|
| • aldrin           | 0.03 µg/l |
| dieldrin           | 0.03 µg/l |
| heptachlor         | 0.03 µg/l |
| heptachlor epoxide | 0.03 µg/l |
| • other pesticides | 0.10 µg/l |
| • total pesticides | 0.50 µg/l |

- 1.2 Pesticides and related products are defined as any organic insecticide, herbicide, fungicide, nematocide, acaricide, algicide, rodenticide, slimicide and any product related to any of these including any growth regulator, and their *relevant* metabolites, degradation and reaction products. *Relevant* should be taken to mean any metabolites, degradation and reaction products that have similar pesticidal properties to their parent pesticides. No guidance has yet been issued by the European Commission but until it is, DWI considers that in, respect of drinking water, there is no evidence at the present time that any pesticide metabolites, degradation or reaction products represent a risk to health and therefore no additional monitoring is required. This Guidance document will be updated in the light of EC guidance on the definition and interpretation of related products and relevant metabolites, degradation and reaction products as it may apply to EC Drinking Water Directive.
- 1.3 The standard for other pesticides applies to each individual pesticide, also including any *relevant* metabolite, degradation and reaction product. Total pesticides means the sum of the detected concentrations of the individual pesticides and any *relevant* metabolites, degradation and reaction products *detected and quantified* in the samples taken on a particular sampling occasion from a sampling point. This definition recognises that more than one sample may be taken on a particular sampling occasion from a sampling point to enable all the pesticides of interest to be determined.

## **PART II**

### **Regulation 3 - Identification of water supply zones**

#### **Delineation and designation of Water Supply Zones**

- 2.1 Regulation 3 came into force on 1 June 2003. Regulation 3(1) requires water companies to pre-designate the names and areas of the supply zones within its supply area for the forthcoming calendar year. Regulation 3(2) specifies that the water supply zone should not supply more than 100,000 people. Regulation 3(3) requires that the designation of the water supply zone should not change through the year.
- 2.2 In the last quarter of each calendar year, water companies should review the designation of their water supply zones to ensure that the delineation remains appropriate and assess revised estimated populations. The population estimates for water supply zones should relate to permanent residents only. During the review, water companies should identify any water supply zone where the revised estimate of resident population supplied exceeds 100,000. Regulation 3(2) and (3) provide that the delineation of such zones should be revised to produce zones with a population below 100,000 in the following year. In general the number of changes to the designation of water supply zones should be kept to a minimum.
- 2.3 A consistent approach is needed in the delineation of water supply zones. Water Companies should therefore first identify which areas are supplied from single sources. A source could be the outlet of a water treatment works, a pumping station, a blending point or a service reservoir. A discrete area supplied from a single source should always be recorded as a single water supply zone unless it supplies more than 100,000 people. In such circumstances the area should be subdivided into water supply zones each with a population of less than 100,000.
- 2.4 The purpose of supply zone delineation is to identify areas of supply which do not have significant differences in water quality. The water quality indicated by sampling within the supply zone should be generally representative of the water quality supplied to the whole area of the zone. It is recognised that in some instances the water quality indicated by a sample taken from the tap may be influenced by the domestic distribution system within a consumer's property.
- 2.5 Any discrete area whether supplied by one or more sources should be sub-divided into separate supply zones if there are or could be significant differences in water quality within the area. Water companies should also take into account the type of water source and only designate supply zones supplied by similar sources within the same water supply zone. Each supply zone would normally be served by an individual service reservoir or water tower, pumping or booster station or would be distinguished as a discrete pressure zone or by other appropriate features of the distribution system.
- 2.6 In areas where the variations in water quality are complex or where the water supplied may be from a number of potential sources via transfer mains, the water supply zone should be delineated by reference to convenient geographical boundaries or by areas served by appropriate features of the distribution system.
- 2.7 Many water companies have delineated their supply areas into district metered areas which under normal operation have a single supply inlet. In such circumstances water supply zones should consist of related district metered areas, which are supplied from common sources.

- 2.8 It is recognised that water companies have to take temporary operational actions to maintain water supplies that may involve the introduction of water from sources not designated for that supply zone. Such temporary measures should not influence the annual designation of water supply zones. If permanent changes to the pre-designated names and areas have to be made during the year the water company should notify DWI of the changes made.

### **3 PART III**

- 3.1 Part III (regulation 4) prescribes standards of wholesomeness in respect of water supplied by water companies for cooking, drinking, food preparation and washing and other domestic purposes and to premises for food production purposes. In particular, regulation 4 provides that water is wholesome if it contains concentrations or values in respect of various properties, elements, organisms and substances that do not contravene the prescribed maximum, and in some cases, minimum concentrations or value (PCV). Some of the PCVs are specified in regulation 4 but most are included in Tables A and B in Schedule 1 of the Regulations.

#### **Regulation 4(3) - Definition of consumer's tap**

##### **Definition of consumer's tap**

- 3.2 The Regulations implement Drinking Water Directive 98/83/EC on the quality of water intended for human consumption. The Directive's standards must be complied with, in the case of water supplied from a distribution network, at the point within premises or an establishment, at which it emerges from the taps that are normally used for human consumption. Water companies are not responsible for any deterioration in water quality that may arise as a result of the domestic distribution system (with the exception of plumbing metals copper and lead where specific regulations apply).
- 3.3 Regulation 4(3) states that the standards for wholesomeness are to be complied with at the consumer's tap except in the case of water supplied from a tanker. Part IV of the Regulations requires monitoring at sampling points and other points to establish whether the water supplied meets the standards for wholesomeness. A sampling point is defined in regulation 2 as being a consumer's tap that is selected for monitoring purposes. Further guidance will be issued regarding monitoring within public buildings.
- 3.4 The consumer's tap is not defined in the regulations. Water companies should assume that the consumers' taps to be used for monitoring to determine compliance with the standards are those taps that are normally used for drinking, cooking, food preparation or other domestic purposes. In a domestic property this tap is normally the kitchen cold water tap that is used for drinking and food preparation purposes irrespective of whether any upstream devices such as softeners or filters are present. Disinfection of the cold water tap is recommended prior to sampling for bacteriological parameters and should follow the guidance given in the Microbiology of Drinking Water Supplies 2002.

#### **Regulation 4(4) - Sampling on transfer from a water treatment works**

##### **Water treatment works**

- 3.5 Regulation 4(4) defines the criteria for wholesomeness on transfer from a water treatment works. Regulation 13(1) requires water companies to ensure that samples for *E coli*, coliform bacteria, colony counts, residual disinfectant, turbidity and nitrite

are taken at the required frequency from the point at which water leaves each treatment works. Sampling for the other parameters within Table 3 of Schedule 3 of the Regulations may be sampled at the treatment works or other authorised supply point.

- 3.6 The sampling point should be located so as to provide a representative sample of the water flowing into distribution. The sample point must be downstream of all treatment processes including blending and any storage in final water storage reservoirs at the treatment works.
- 3.7 Where the treatment stream within a works divides in such a way that a single final water compliance point will not be representative of all water leaving the works (i.e. there are different treatment streams which leave the works through different outlet mains), then more than one sampling point will be required. Where there is a possibility of differences in water quality within different outlet mains leaving the treatment works then separate sampling points are required for each different final water. Although on the same site, each treatment train is regarded as a separate water treatment works for the purposes of the Regulations.
- 3.8 All treatment works outlets should be fitted with metal sampling taps of a hygienic design which do not have attachments or inserts and which are made from materials complying with BS6920. Water should be supplied to the sampling tap through a sample line of a suitable material, which if plastic, complies with BS6920. Sample lines should be kept as short as possible.
- 3.9 Water companies may receive inputs of treated water from neighbouring water companies termed as "Bulk supplies". Such supplies should not be monitored within the compliance sampling programme as water leaving a treatment works (as this will be undertaken by the water company who operates the treatment works). It would be prudent to undertake water quality monitoring of such supplies at the point of transfer on an operational basis. The bulk supply input point may be an appropriate location for authorised supply point monitoring if this monitoring option is being used by the water company receiving the bulk supply.

#### **Regulation 4(5) - Sampling on transfer from a service reservoir**

##### **Service reservoir**

- 3.10 Regulation 4(5) defines the criteria for wholesomeness on transfer from a service reservoir. Regulation 14 requires water companies to ensure that a sample is taken for bacteriological analysis and determination of residual disinfectant in each week the reservoir is in use. Water Companies should be confident that samples taken are representative of the water from each service reservoir.
- 3.11 The Regulations define a service reservoir as any structure in which a reserve of treated water is contained and stored for the purposes of meeting a variable demand for the supply of water. The definition specifically excludes any structure at a water treatment works such as final water storage reservoirs. Sampling points at water treatment works should be located so as to provide a representative sample of the water flowing into distribution and this should be downstream of any final water storage reservoirs at the treatment works.
- 3.12 Break pressure tanks should not be designated as service reservoirs unless they are designed to provide strategic water storage. Some water companies have water retaining structures which are solely connected to further service reservoirs and do

not supply consumers directly via distribution mains. If such water retaining structures contain strategic reserves of water they should be classified as service reservoirs and sampled within the compliance sampling programme.

- 3.13 Where a service reservoir has more than one compartment with its own water inlet and outlet and the compartments are not connected hydraulically to any other compartments, then each compartment should be regarded as a single service reservoir. Sampling is required at the outlet main of each compartment unless the individual outlets subsequently combine into a single common outlet main.
- 3.14 Where a service reservoir has more than one compartment but the compartments are hydraulically connected then the connected compartments may collectively be regarded as a single service reservoir and be sampled accordingly.
- 3.15 Where a service reservoir has a single common inlet and outlet main, the water company must have arrangements to ensure that samples are taken only when the main is acting as an outlet and the water quality is therefore representative of water that has been stored within the service reservoir. Where this is not practicable alternative representative sampling arrangements can be made.
- 3.16 All service reservoir outlets should be fitted with metal sampling taps of a hygienic design which do not have attachments or inserts and which are made from materials complying with BS6920. Water should be supplied to the sampling tap through a sample line of a suitable material, which if plastic, complies with BS6920. Sample lines should be kept as short as possible.

#### **Other sampling arrangements at water treatment works and service reservoirs**

- 3.17 It is not possible for this Guidance to describe all the possible arrangements for the siting of regulatory sampling points at water treatment works and service reservoirs. Where water companies are unsure about the number or siting of regulatory sampling points they should submit details of their proposals to DWI for approval.

## **PART IV**

### **Regulation 6(1) - Monitoring: numbers of samples**

#### **Monitoring: numbers of samples**

- 4.1 Regulation 6(1) states that water companies shall take and analyse not less than the number of samples specified within the provisions of Part IV. A water company may programme and report more than the minimum number specified for any parameter to ensure that the minimum sampling and analysis requirement is met.
- 4.2 It is recognised that water companies will wish to carry out some additional sampling to provide additional information on the quality of water supplies. Water companies may prefer to manage such monitoring within a separate non-compliance sampling programme with individual samples identified by a separate sample reason code.
- 4.3 Water companies may carry out sampling for both compliance and non-compliance purposes on the same sampling occasion provided that the samples taken are identified by separate unique sample numbers or other auditable process (with the appropriate sample reason).
- 4.4 If water companies wish to carry out additional sampling within the regulatory monitoring programme they should not programme significantly above the numbers specified for selected parameters in order to influence compliance statistics.

### **Regulation 6(2) - Monitoring: general provisions**

#### **Monitoring for pesticides – monitoring strategy**

- 4.5 It is not practical or necessary to monitor for every pesticide that is used within the catchment of a water source. The Drinking Water Directive recognises this by noting that only those pesticides which are likely to be present in a given supply need to be monitored.
- 4.6 To effectively implement the requirement of the Drinking Water Directive, each water company is required to develop a monitoring strategy for pesticides at each treatment works based on the likely risk of particular pesticides being present in the water source or sources from which water is abstracted for treatment at that treatment works. In developing a monitoring strategy water companies are expected to:
  - (i) assess as far as is practicable which pesticides are used in significant amounts within the catchment area of each water source;
  - (ii) assess as far as is practicable on the basis of the properties and method of use of these pesticides, and local catchment knowledge, whether any of these pesticides are likely to reach each water source in the catchment area;
  - (iii) take into account the results of any monitoring for pesticides in water sources within the catchment area carried out by the Environment Agency;
  - (iv) take into account the results of any operational monitoring of water sources or water supplies for pesticides carried out previously by the water company; and

- (vi) take into account the results of the compliance monitoring of water supplies for pesticides carried out under the provisions of the Water Supply (Water Quality) Regulations 1989 (1989 Regulations).
- 4.7 On the basis of that strategy, the water leaving each treatment works (or supply point) should be monitored at the frequency specified in Table 3 of Schedule 3 of the Regulations for each of the pesticides identified as likely to reach a water source from which water is abstracted to that treatment works. Where a treatment works has a treatment process installed to remove pesticides or reduce the concentration of pesticides, the water company must include in its monitoring strategy for that treatment works those pesticides for which the treatment process has been installed.
- 4.8 Aldrin, dieldrin, heptachlor and heptachlor epoxide must be included in the monitoring strategy for each treatment works unless the water company has convincing evidence that these pesticides are not detected in the water supplied from the treatment works. DWI recognises that these pesticides have not had approved use for many years and that a monitoring programme for these pesticides may not be necessary. However they can be persistent in the environment and occasional detections in drinking water have occurred. If water companies are of the opinion that there is no need to monitor for these pesticides they submit a reasoned case, backed up with whatever data are available. Normally this should include a minimum of three years' data from the most recent period when monitoring was conducted. The data must have a limit of detection well below the new standard. The frequency of monitoring should be at least that specified in the Regulations. Where appropriate, regulatory data can be supplemented by relevant operational data, or data from other organisations such as the Environment Agency.
- 4.9 If at any time a water company has any reasonable grounds for believing that a pesticide not included in its monitoring strategy for a particular works could be present at a concentration in excess of the standard, it must include that pesticide in its monitoring strategy for that works. It may also be appropriate and advisable for the water company to carry out operational monitoring for that pesticide in the water source or sources from which water is abstracted to the treatment works in order to provide additional information about the behaviour of the pesticide.
- 4.10 Towards the end of each calendar year, each water company should review its monitoring strategy for each treatment works using the guidance in paragraph 4.6 above. A particular pesticide may be omitted from the monitoring strategy if it has not been detected at significant concentrations in the water supplied from the works in the previous three calendar years compliance monitoring under the 1989 regulations or the new Regulations. A pesticide for which a treatment process has been installed, can only be omitted from the monitoring strategy for that treatment works if the water company can show, from at least three years' operational monitoring of the water source or sources from which the water is abstracted, that the pesticide is no longer detected at significant concentrations in the water source or sources.
- 4.11 It is recognised that particular analytical methods for pesticides enable a suite of pesticides of similar chemical structure or properties to be determined. Water companies may continue to monitor all the pesticides in the suite even if a particular pesticide could be omitted because it had not been detected in the previous three years.
- 4.12 The standards for pesticides apply at consumers' taps. However, regulation 8(1) allows water companies to monitor compliance with those standards by taking

samples for pesticides from supply points because the results of the analysis of such samples are unlikely to differ in any material respect from the results of the analysis of samples taken from consumers' taps. Water companies receiving small bulk supplies from other companies may use the originating company's pesticide monitoring data for that supply.

### **Regulation 6(3) - Monitoring : Sampling - tankers**

#### **Monitoring : Sampling – tankers**

- 4.13 Regulation 4(3) defines the point of compliance as the consumer's tap or in the case of water supplied by tanker, the point at which the water emerges from the tanker. Regulation 6(3) requires water companies to take samples from water tankers in specified circumstances. Within England and Wales water is not normally distributed by tanker except on occasion for short term supplies associated with operational work or emergency provisions. Regulation 6(3) does not apply to the use of tankers to fill service reservoirs.
- 4.14 For the purposes of these Regulations water tankers are considered as any mobile water tank used to provide water supplies to consumers on a temporary basis and includes water bowsers. Water tankers should only be filled with wholesome water from a known source.
- 4.15 The Regulations require monitoring for *E coli*, hydrogen ion and conductivity from each tanker that has been providing water for longer than 48 hours. Any tanker that has been providing water continuously for more than 96 hours must be sampled and analysed for full microbiological and chemical analysis. Further samples for full microbiological and chemical analysis must be taken every additional 48 hours that the tanker is in use. Provided tankers are collected or emptied before a 48 hour period has elapsed there is no monitoring requirement. A tanker should only be filled and re-filled with wholesome water.

### **Regulation 6(6) - Monitoring : copper, lead and nickel monitoring**

- 4.16 The Regulations require sampling of water supplies at the consumer's tap for copper, lead and nickel at the audit frequency specified in Table 2 of Schedule 3. Samples for these parameters must always be taken at consumers' taps. The sampling point should be selected from the random sampling programme and the sample should be the first one litre of water drawn from the tap without flushing.

### **Regulation 6(7) - Monitoring : Radioactivity monitoring**

- 4.17 The Regulations require sampling of water supplies for the determination of radioactivity. Sampling is to be undertaken at audit frequency specified in Table 2 or Table 3 of Schedule 3. Analysis is required for tritium as an individual radionuclide which is effectively a screening parameter for the presence of contamination by artificial radionuclides. Monitoring for total indicative dose (TID) is routinely achieved by analysis for gross alpha and gross beta activities although it is calculated from the activities of individual radionuclides using the summation formula in the EC guidance document (see 4.25). Calculation of TID is only required if any of the screening values for gross alpha, gross beta or tritium are exceeded.
- 4.18 Monitoring of drinking water for Total Indicative Dose (TID) shall be necessary where a source of artificial or enhanced natural radioactivity is present within the catchment and it cannot be shown on the basis of other surveillance programmes or

investigations that the level of TID is well below its parametric indicator value of 0.1 mSv/year. Where monitoring for artificial radionuclide levels is required, it shall be carried out at the audit frequency.

- 4.19 Where monitoring for natural radionuclide levels is required, DWI will define an appropriate frequency considering all relevant available information provided by the water companies on temporal variations of natural radionuclide levels in different types of waters. Depending on the expected variations, monitoring frequency may vary from a single check-up measurement up to the frequency of audit monitoring. Where only a single check-up for natural radioactivity is required, a re-check shall be required at least where any change occurs in relation to the supply likely to influence the concentrations of radionuclides in the drinking water.
- 4.20 Where methods for removing radionuclides from drinking water have been introduced to ensure that a parametric indicator value is not exceeded, monitoring shall be carried out at the audit frequency.
- 4.21 Water companies should use screening methods for gross alpha activity and gross beta activity to monitor for the parametric indicator value for TID. If the gross alpha and the gross beta are less than 0.1 Bq/l and 1.0 Bq/l respectively, the water company may assume that the TID is less than the parametric indicator value of 0.1 mSv/year and no further radiological investigation is needed. If the gross alpha activity exceeds 0.1 Bq/l or the gross beta activity exceeds 1.0 Bq/l, analysis for specific radionuclides shall be required. The radionuclides to be measured shall be defined by taking into account all relevant information about likely sources of radioactivity. Where necessary, tritium, gross alpha activity and gross beta activity should be measured in the same sample.
- 4.22 Appendix 4 contains a flow chart which gives guidance on two key issues:
  - (i) the need for statutory monitoring for total indicative dose; and
  - (ii) how to respond to results for gross alpha and beta activity.

The flowchart attempts to deal with a variety of circumstances but does not attempt to specify the form of any more detailed analysis. This must be judged on a case by case basis. The flow chart does not apply to monitoring for tritium.

- 4.23 Instead of the gross alpha and gross beta activity screening discussed above, water companies may use screening methods for specific radionuclides to indicate reliably the presence of radioactivity in drinking water. If one of the activity concentrations exceeds 20% of its reference concentration (see Table 1 below) or the tritium concentration exceeds its parametric value of 100 Bq/l, analysis of additional radionuclides shall be required. The radionuclides to be measured shall take into account all relevant information about likely sources of radioactivity.
- 4.24 Regulation 6(7) permits DWI to notify water companies that monitoring for radiological parameters is not required where they are satisfied that the water supply is well below the specification for the relevant parameters. DWI will inform water companies by Notice where it has been satisfied that there is sufficient information to establish that water supplies meet these criteria and there is therefore no need for audit monitoring.

### Calculation of the Total Indicative Dose (TID)

- 4.25 The TID is the committed effective dose for one year of intake resulting from all the radionuclides whose presence in a water supply has been detected, both of natural and artificial origin but excluding tritium, potassium-40, radon and radon decay products. The TID is calculated from the radionuclide concentrations and the dose coefficients for adults laid down in Annex III, Table A of European Directive 96/29/Euratom (laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation). Where the following formula is satisfied, water companies may assume that the TID is less than the parametric indicator value of 0.1 mSv/year and no further investigation is required:

$$\sum_{i=1}^n \frac{C_i(\text{obs})}{C_i(\text{ref})} \leq 1$$

where  $C_i(\text{obs})$  = observed concentration of radionuclide  $i$   
 $C_i(\text{ref})$  = reference activity concentration of radionuclide  $i$  (Table 1)  
 $n$  = number of radionuclides detected.

- 4.26 Where the formula is not satisfied, the parametric indicator value will only be exceeded if the radionuclides are persistently present at similar activity concentrations for a full year. DWI will define the degree of resampling necessary to ensure that the measured values are representative for an average activity concentration for a full year. Where representative sampling shows that the parametric indicator value is exceeded DWI will advise what action is necessary to achieve compliance.

**TABLE 1**  
**Reference concentrations for radioactivity in drinking water<sup>1</sup>**

Origin	Nuclide	Reference concentration
Natural	U-238 <sup>2</sup>	3.0 Bq/l
	U-234 <sup>2</sup>	2.8 Bq/l
	Ra-226	0.5 Bq/l
	Ra-228	0.2 Bq/l
Artificial	C-14	240 Bq/l
	Sr-90	4.9 Bq/l
	Pu-239/Pu-240	0.6 Bq/l
	Am-241	0.7 Bq/l
	Co-60	40 Bq/l
	Cs-134	7.2 Bq/l
	Cs-137	11 Bq/l
	I-131	6.2 Bq/l

<sup>1</sup>This table includes the most common natural and artificial radionuclides. Reference concentrations for other radionuclides can be calculated using the dose coefficients for adults laid down in Annex III, Table A of Directive 96/29/Euratom, or more recent information recognised by the competent authorities in the Member State, and by assuming an intake of 730 litres per year.

<sup>2</sup> One milligram (mg) of natural uranium contains 12.3 Bq of U-238 and 13 Bq of U-234. Table 1 allows only for the radiological properties of uranium, not for its chemical toxicity.

## **Monitoring for tritium**

- 4.27 Monitoring of drinking water for tritium shall be necessary where a source of tritium is present within the catchment and it cannot be shown on the basis of other surveillance programmes or investigations that the level of tritium is well below its parametric indicator value 100 Bq/l. Where monitoring for tritium is required, it must be carried out at the audit frequency.
- 4.28 Tritium was included in the Drinking Water Directive on the basis that it provides an indication of other, potentially more harmful, artificial radionuclides discharged into the environment. In the UK such discharges are subject to stringent controls and even where authorised discharges of artificial alpha and beta emitters occurs within the water catchment the concentrations of tritium are low and routinely below 10 Bq/l.
- 4.29 In these circumstances monitoring of tritium in drinking water would be a check on on-going discharges of radioactivity to the environment. Environmental sampling programmes already exist tailored to sample close to the source of discharges. Elevated concentrations of tritium have been associated with landfill leachates where the tritium probably derives from the disposal of gaseous tritium lighting devices and is not an indicator of other artificial radionuclides. In these cases elevated gross beta activity has also been detected in the water, probably due to the presence of particulates and natural potassium-40. The relationship between tritium and landfill sites is best investigated by research projects rather than routine monitoring.
- 4.30 It is not considered necessary for water companies to carry out routine monitoring for tritium in drinking water sources unless there is evidence of elevated beta activity or water companies have reason to believe it may be significantly present.

## **Regulation 7 - Sampling point – random selection**

### **Random selection of sampling points**

- 4.31 Regulation 7 requires all sampling points to be selected at random except in relation to those parameters where monitoring from supply points has been authorised. Water companies are expected to use a sampling programme that selects sample points at random from a comprehensive list of its consumers.
- 4.32 Water companies' methods should ensure random selection from a customer list to produce an individual target address or a sampling location such as a designated street or a designated postcode. If a sample cannot be obtained from the target sample address a neighbouring property should be chosen and appropriate records amended accordingly. A check should always be made to ensure that any alternative address is within the target water supply zone, especially when properties are close to the water supply zone boundaries.
- 4.33 DWI expects water companies to be able to obtain samples from randomly selected sample points in most circumstances. In exceptional circumstances water companies may apply to DWI to use an alternative method of selection for sample points.
- 4.34 DWI is aware that some water companies have concerns regarding the security of samplers in some specific locations. Where a water company considers that these concerns prevent the implementation of sampling by random selection of sample

points it should provide DWI with information on its alternative method. DWI will indicate whether the alternative method is acceptable.

### **Regulation 8(1) - Authorisation of supply points**

- 4.35 Regulation 8(1) authorises the use of supply points for monitoring specified parameters. Supply points may be:
- treatment works
  - service reservoirs
  - blending points
- 4.36 In addition to these designated supply points, under regulation 8(2) subject to paragraph (3), water companies may apply to use fixed sample taps fitted directly to principal distribution mains for parameters not specified by regulation 8(1). Water companies should ensure that sample points are fitted with metal sampling taps of a hygienic design which do not have attachments or inserts and which are made from materials complying with BS6920. They should be fitted in such a way as to ensure that the sample is representative of the water in the main.
- 4.37 A blending point means a point at which treated waters, originating from two or more sources, are combined under controlled conditions. In practice blending is normally accomplished by the controlled mixing of treated waters in service reservoirs and specific sections of trunk main.
- 4.38 The position of any authorised supply point at a blending point should be carefully selected to ensure that adequate mixing has taken place prior to the sample point. There should be no subsequent significant change in the value or concentration of the authorised parameters between the supply point and consumer's taps.

### **Regulation 8(2) - Authorisation of parameters for supply point monitoring**

- 4.39 The Drinking Water Directive permits the use of monitoring at supply points for parameters provided that for any particular parameter it can be demonstrated that there would be no adverse change to the measured value. Regulation 8(3) allows DWI to authorise sampling from either a supply point as specified in regulation 8(1) or another supply point instead of sampling points (consumers' taps) for parameters other than those specified in Regulation 8(1) when DWI is satisfied that the results of the analysis of samples taken from the supply point are "unlikely to differ in any material respect" for a particular parameter from the results that would be produced from the analysis of samples taken from sampling points. Where DWI authorises particular parameters to be monitored at supply points, the sampling frequency should be that applying to audit monitoring in Table 3 of Schedule 3.
- 4.40 In respect of the following parameters, it is unlikely that authorisation to sample from supply points will be given because the results may "differ in a material respect":
- (i) *E.coli*, coliform bacteria and colony counts, as these are likely to change in concentration through the distribution system;
  - (ii) lead, copper, nickel and chromium because these metals can be present from contact of the water supplied with plumbing materials;

- (iii) iron, manganese and aluminium because these metals can be present in water leaving treatment works and picked up from deposits in the distribution system;
- (iv) polycyclic aromatic hydrocarbons and benzo(a)pyrene because these substances can be present from contact of the water supplied with coal tar pitch linings within the distribution system;
- (v) colour, taste, odour and turbidity because these characteristics of the water supply can be affected by the condition of the distribution system and consumers' plumbing systems;
- (vi) hydrogen ion because this can change as the water passes through the distribution system and by treatment equipment within consumers' premises;
- (vii) sodium because this can increase when sodium hypochlorite is added during distribution and when treatment equipment is used within consumers' premises;
- (viii) ammonium and nitrite because these concentrations are likely to change as the water passes through the distribution system due to microbiological reactions and when chloramination is practised;
- (ix) nitrate because of the need to calculate the nitrate / nitrite formula; and
- (x) trihalomethanes when the water supply originates from or is influenced by surface water as the concentrations leaving the treatment works are likely to vary significantly as the water passes through the distribution system. Groundwaters are influenced by surface waters when water quality changes occur as a result of rainfall or changes in river flows.

4.41 Authorisation to sample from supply points could be considered in the following circumstances because the results are unlikely to differ in "any material respect":

- (i) for antimony, arsenic, cadmium and selenium when the water company can demonstrate for a particular supply or supplies that these metals have not been detected at significant concentrations in samples taken from consumers' taps for at least two years; and
- (ii) for trihalomethanes when the water supply zones are supplied with water that originates solely from groundwater and the water company can demonstrate that the concentrations at consumers' taps have been an average of 30 µg/l or less for at least two years and not exceeded 50 µg/l in that time.

#### **Regulation 9(1) - Monitoring : numbers of samples**

4.42 The majority of parameters require monitoring at either a check monitoring (high) or audit monitoring (lower) frequency exclusively. There is also a range of monitoring at intermediate frequencies for the six parameters to be monitored at the water treatment works. There are six parameters which can **either** be monitored at check monitoring frequency, or at audit monitoring frequency, depending on the following circumstances:

- (i) aluminium and iron are to be monitored at the lower audit monitoring frequency unless they are used as a flocculant or the water originates from, or

- is influenced by surface waters, in which case the higher check monitoring frequency applies;
- (ii) manganese is to be monitored at the lower audit monitoring frequency in Schedule 3 Table 2 unless the water originates from, or is influenced by surface waters, in which case the higher check monitoring frequency applies.
  - (iii) *Clostridium perfringens* is to be monitored at the audit monitoring frequency in Schedule 3 Table 2 or Table 3 unless the water originates from, or is influenced by surface waters, in which case the higher check monitoring frequency applies.
  - (iv) nitrite and nitrate are also to be monitored at the lower audit monitoring frequency in water supply zones unless chloramination is practised at the water treatment works, in which case the higher check monitoring frequency applies in the water supply zones. **In addition** there is a requirement to monitor for nitrite at the water treatment works, against the 0.1 mg/l standard. Nitrite is to be monitored at the water treatment works at the lower audit monitoring frequency in water supply zones unless chloramination is practised, in which case the higher monitoring frequency specified in Table 3 of Schedule 3 applies; and also
  - (v) water companies should consider undertaking additional operational monitoring at groundwater sources which have significant natural concentrations of iron and/or manganese.
- 4.43 The requirements for nitrate and nitrite monitoring are illustrated in the following examples:

#### **Example A**

A water treatment works, which practises chloramination, has an annual average output of 25,000 m<sup>3</sup>/d and supplies three water supply zones with populations of WSZ1 25,000, WSZ2 35,000, and WSZ 3 65,000.

##### **Monitoring required at WTW**

Nitrite (against standard of 0.1mg/l) – 365 samples per annum (standard frequency)

##### **Check monitoring required in water supply zones**

Nitrite (against standard of 0.5mg/l) and nitrate (against standard of 50 mg/l)

WSZ1 – 24 samples per annum (at standard frequency)

WSZ2 – 36 samples per annum (at standard frequency)

WSZ3 – 52 samples per annum (at standard frequency)

#### **Example B**

A water treatment works, which does not practise chloramination, has an annual average ouput of 10,000 m<sup>3</sup>/d and supplies two water supply zones with populations of WSZ1 4,000 and WSZ2 56,000.

##### **Audit monitoring required at WTW**

Nitrite (against standard of 0.1mg/l) – 8 samples per annum

##### **Audit monitoring required in water supply zones**

Nitrite (against standard of 0.5mg/l) and nitrate (against standard of 50 mg/l)

WSZ1 – 4 samples per annum  
WSZ2 – 8 samples per annum

### **Regulation 9(1) - Monitoring : Analysis using monitors**

- 4.44 Regulation 16(3) extends the scope of the term “laboratory” to a person who may undertake analysis at the time and place at which the samples are taken. This allows the potential use of results from continuous water quality monitors for certain parameters e.g. turbidity and conductivity.
- 4.45 The results from continuous water quality monitors could only be used if the following criteria are met:
- (i) the monitor must be capable of satisfying the prescribed performance characteristics for analysis of that parameter as specified in regulation 16(5);
  - (ii) there must be a mechanism to predetermine the times and dates at which results are to be determined. Pre-determination does not necessarily require a fixed time and day to be specified. A system to randomly pre-select the time and day of the statutory result would be acceptable; and
  - (iii) the water company must maintain records to establish that the appropriate requirements of regulation 16(2) are met.

### **Regulation 9(2) - Numbers of samples - reduced frequency**

#### **Reduced frequency**

- 4.46 Regulation 9(2) allows a water company to take a reduced number of samples for those parameters that are subject to check monitoring provided specified conditions are met.
- 4.47 One of the conditions is that the water company is of the opinion that the quality of water supplied by it to a water supply zone is unlikely to deteriorate. A water company would be expected to take into account when reaching its opinion the following factors. Whether there:
- (i) has been any change in the activities within the catchment or the condition of the catchment which is likely to have an adverse effect on the quality of the raw water;
  - (ii) is any evidence of a general deterioration in the quality of the raw water, or the water supplied from the treatment works
  - (iii) is any evidence of a general deterioration in the quality of water as it passed through the distribution system to consumers' properties.
- 4.48 Another of the conditions is that the results of the analysis of samples in each of two successive years (or the results of the last 12 samples where less than this number has been taken in two years) show no significant variation and, except for colony counts and pH value, the concentration or value is significantly lower than the prescribed concentration or value. The following paragraphs give guidance on specific parameters.

- (i) For the parameters aluminium, ammonium, colour, conductivity, iron, manganese, nitrate, nitrite and turbidity, a significant variation is when any result deviates from the arithmetic mean concentration or value, in either of the two years, (or in the results of the last 12 samples where less than this number has been taken in two years) by more than 20% of the prescribed concentration or value. For these parameters significantly lower is when all the values in each year (or in the results of the last 12 samples where less than this number has been taken in two years) are below 50% of the prescribed concentration or value.
- (ii) For taste and odour a reduced frequency can only be applied when all the results in the previous two years (or in the results of the last 12 samples where less than this number has been taken in two years) have been 1 dilution number.
- (iii) For *Clostridium perfringens* (including spores) a reduced frequency can only be applied when the organism has not been detected in any of the samples taken in the two years (or in the results of the last 12 samples where less than this number has been taken in two years).
- (iv) For colony counts, no significant variation and no abnormal change is when all the results obtained in the two years (or in the results of the last 12 samples where less than this number has been taken in two years) are within plus or minus one order of magnitude of the mean.
- (v) For the hydrogen ion parameter, no significant variation is when all the results for pH value in the two years (or in the results of the last 12 samples where less than this number has been taken in two years) are within a spread of 1 pH unit. A reduced frequency cannot be applied when any result is below a pH value of 6.5 or above a pH value of 10.0.

#### **Regulation 9(4) - Numbers of samples – regular intervals**

##### **Regular intervals**

- 4.49 Regulation 9(4) requires samples to be taken at regular intervals. Regular sampling means having a suitable spread of samples to detect possible variation in water quality. Variation could occur on long term (seasonal) or more short term (within a week or day due to operational changes) basis. The requirement for regular sampling does not mean that the sampling occasions have to be spread at exactly equal intervals. For water supply zones the most common sample frequencies are 12, 24 and 36 per annum. Samples should generally be taken at one, two or three times per month. It is important that there is a good spread between the sampling events. For sampling frequencies of 52 and 76 per annum samples should be taken once and sometimes twice a week to meet the targets. Ideally the day within each week that the sample is taken should be randomised. However it is recognised that it may not be practicable to fully randomise the day of sampling. Where the sources of supply or operation of a works, service reservoir or zone are known to vary significantly over the period of a week, the sampling programme should be managed to ensure some variation in the day of the week in which the sample is taken.
- 4.50 For service reservoirs, samples should be taken in each week that the service reservoir is in operation. Ideally the day within each week that the sample is taken should be randomised. However it is recognised that it may not be practicable to fully randomise the day of sampling and in such cases the sampling programme should

be managed to ensure some variation in the day of the week in which the sample is taken.

## **Summary**

4.51 A summary of the sampling requirements for each parameter is given in the Table in Appendix 7.

## PART V

### 5 Regulation 13 - Sampling at treatment works

- 5.1 Regulation 13(2) provides for a reduced frequency of sampling for the colony counts parameter when there has been no significant increase in the counts in each of two successive years. Colony counts, particularly for surface water derived supplies, are likely to vary seasonally because of changes in quality and temperature. A significant increase should be regarded as a count which is more than one order of magnitude greater than that normally expected for the time of year the sample was taken.
- 5.2 Regulation 13(4) provides for a reduced number of samples for the coliform bacteria parameter and the *E. coli* parameter only when the water company is of the opinion:
- (a) that there is no foreseeable risk that the supply will exceed the maximum concentration for the parameter; or
  - (b) that the treatment works is designed to secure that, in the event of a failure of the disinfection process, water that has not been disinfected cannot enter the supply.
- 5.3 In respect of (a), a water company would be expected to take into account when reaching its opinion the following factors:
- (i) risk factors and activities in the catchment from which the water source is drawn;
  - (ii) the concentrations of the parameter in the raw water;
  - (iii) the nature and capability of the treatment processes at the works; and
  - (iv) the concentration of the parameter in the water leaving the treatment works over the previous two years.
- 5.4 In respect of (b), this requirement would be met when:
- (i) a treatment works automatically shuts down almost immediately after a disinfection failure is detected; or
  - (ii) procedures are in place for a treatment works to be manually shut down almost immediately after an alarm is received warning of a disinfection failure.
- 5.5 It is unlikely that a reduced frequency could be applied to only one of the coliform bacteria or *E.coli* parameters.
- 5.6 Regulations 13(2) and 13(4) deal with the adoption of reduced frequency monitoring. Where there is a failure to meet the PCV or an exceedence of an indicator parameter value occurs at a treatment works where reduced frequency monitoring has been adopted, sampling should be increased to the standard frequency on a pro rata basis for the remainder of that year and the two following calendar years.
- 5.7 Sampling frequencies are normally based on the volume of water supplied in m<sup>3</sup>/day. Sampling frequencies should be based on the average daily output from the works during the previous calendar year except where it is known that the current year's

average daily output will be significantly different from the previous average daily year's output. Where there is more than one outlet at a works requiring separate sampling points (as explained in paragraph 3.7), the sampling frequency should be determined separately for each sampling point based on the average daily output at each point.

- 5.8 Normally water companies would be expected to establish prior to the start of the calendar year, their annual sampling frequency for each works based on the previous year's average daily output from the works or the anticipated average daily output for the current year. Water companies with treatment works whose output may vary considerably at different times of the year for extended periods should consider adjusting the frequencies in accordance with the average daily output for those periods.
- 5.9 Regulation 13(5) requires samples to be taken at regular intervals. For water treatment works sampling frequencies may range from 2 to 2,190 per annum. A sample frequency of 365 per annum requires a sample to be taken on each calendar day of the year (and should include February 29 in each leap year). For sample frequencies in excess of 365 per annum, samples should be taken over as large a daily span as is possible. They do not have to be spread at exactly equal intervals but should be broadly spread to be representative of any potential changes in water quality during the day. There must be a mechanism to pre-determine the time of sampling
- 5.10 For sampling purposes a treatment works is considered to be in service on every day (midnight to midnight) that any treated water is supplied from the works.

#### **Regulation 16 - Collection of samples**

- 5.11 Regulation 16 specifies the minimum quality requirements for the taking, handling, storage and analysis of samples taken for the regulatory monitoring of water supplies. These requirements are set out in regulations 16(2) and 16(5). Regulation 16(4) sets out the requirement for the retention of records to demonstrate that the sampling, transport, storage and analysis of each sample complied with the requirements. Other paragraphs cover definitions and the procedure for authorising the use of alternative methods for microbiological analysis.
- 5.12 This regulation does not apply to *Cryptosporidium* analysis for the purposes of Part VII of the Regulations.

#### **Regulation 16(2)**

- 5.13 Sub paragraphs (a) and (b) require that the sample is representative of the quality of the water being sampled at the time of sampling and that the sample is not contaminated when being taken. Sub paragraph (c) specifies that samples must be kept in conditions that will ensure that the sample does not deteriorate in any significant way between sampling and the commencement of analysis.
- 5.14 Water companies, or their sampling contractor, should produce a comprehensive sampling manual setting out the procedures and precautions to be adopted for each parameter or group of parameters.

### **Sampling Manual for microbiological parameters**

- 5.15 As a minimum, the sampling manual should include relevant information on the types of sample bottle, the preparation of sample bottles, the sampling procedures and the transportation of samples. Details of recommended sampling procedures are given in 'The Microbiology of Drinking Water 2002 Part 2'.

### **Sampling Manual for all other parameters**

- 5.16 The nature of parameters varies widely, and a range of sample containers, cleaning regimes, and methods of sample preservation and storage will be required. For example, mercury is highly volatile even at low temperatures, and requires the addition of preservative at the time of sampling. Polycyclic aromatic hydrocarbons react with chlorine and are light-sensitive and require the immediate destruction of chlorine and storage in the dark. Other parameters are volatile or subject to biological degradation and require immediate refrigeration.
- 5.17 As a minimum the sampling manual should specify:
- (i) the types of bottles or containers, their closures and the purposes for which they are to used;
  - (ii) where relevant, the cleaning procedure and shelf life for bottles, containers and closures used for each parameter, including the amount and type of preservative to be added;
  - (iii) the sampling procedure for each parameter, including the type of sample to be collected (eg first draw, flushed, stagnation) and the procedure for collecting samples for different parameters;
  - (iv) the order of sampling; and
  - (v) the conditions of storage and transport of samples and the maximum time that can elapse before analysis should commence for each parameter.

- 5.18 Further general information on sampling procedures is given in 'General Principles of Sampling and Accuracy of Analytical Results' in the series 'Methods for the Examination of Water and Associated Materials' published by the Standing Committee of Analysts. Detailed information for individual parameters or groups of parameters is given in the individual booklets in the same series.

### **Training of samplers**

- 5.19 In order to carry out sampling correctly it is essential that all samplers are fully trained and competent before they are allowed to work unsupervised. The water company or its sampling contractor should produce a comprehensive sampler training programme to cover all aspects of sampling.
- 5.20 Once trained, all samplers' performance should be monitored and subject to regular audit. Monitoring and audit procedures, and criteria for satisfactory performance and policy on retraining should be documented.
- 5.21 A training record should be produced for each sampler detailing the training given, with dates and assessment of competence, results of any audits, any retraining or further training given and any re-assessment of competence.

5.22 Sub-paragraph (d) requires that all samples are analysed as soon as possible after they have been taken, by and under the supervision of a competent person using suitable equipment.

### **Regulation 16 – Analysis of samples**

5.23 Detailed advice on this part of the Regulations is given in Appendix 1.

## **PART VI**

### **Regulation 17(1) - Investigations**

#### **Investigations: Schedule 1 parameters**

- 6.1 A summary of the investigations for Schedule 1 parameters is given in Appendix 2. Note that where the DWI agrees the exceedence is trivial and unlikely to reoccur then no further action is necessary
- 6.2 Regulation 17(1) requires a water company that has reason to believe that the water supplied fails, or is likely to fail, to meet the standards of wholesomeness specified in regulation 4 and Schedule 1, to investigate the cause of that failure or likely failure. Similarly regulation 17(3) requires a water company to investigate the cause of any failure or likely failure to meet the concentration or value required in an authorisation.
- 6.3 The definition of a failure is clear. It is when the analysis of a sample taken as required by the Regulations exceeds a concentration or value specified for the parameters in Schedule 1 of the Regulations. However, the terms of "likely to fail" or "likely failure" are not defined in the Regulations.
- 6.4 A water company may have reason to believe that the water supplied is likely to fail in the following circumstances:
  - (i) there is evidence from the analysis of samples taken as required by the Regulations that the trend in the concentration or value of a particular parameter is generally and steadily increasing (or decreasing) towards the prescribed concentration or value and if that trend continues the water is likely to fail to meet the prescribed concentration or value in the future, say within five years. Such evidence may be available for the nitrate parameter for example
  - (ii) no regulatory samples are in non-compliance with the prescribed concentration or value for a particular parameter but, there is evidence from the analysis of non-regulatory samples such as operational control samples or samples taken in response to incidents or consumer complaints that the prescribed concentration or value has been breached.
  - (iii) no regulatory samples have exceeded the prescribed concentration or value for a particular parameter but, there is evidence from the analysis of non-regulatory samples such as operational control samples or samples taken in response to incidents or consumer complaints that the concentration or value is generally and steadily increasing (or decreasing) towards the prescribed concentration or value. And if that trend continues the water will fail to meet the prescribed concentration or value in the future, say within 5 years.

#### **Regulation 17(2) - Failures attributable to the domestic distribution system**

- 6.5 Regulation 17(2) requires water companies to investigate whether a failure to achieve the prescribed concentration or value may be attributable to the domestic distribution system or its maintenance or neither.
- 6.6 Bacteriological parameters may be influenced by the condition of the domestic distribution system and particularly the design and hygienic status of the consumer's tap. Where a failure to achieve the prescribed concentration for Enterococci and *E*

*coli* occurs the water company should investigate the cause by taking further samples which may include:

- the original sample point
- alternative consumer taps (only taps directly connected to the supply main) at the same property and at adjacent or nearby properties
- further sampling from related points upstream and downstream in the distribution main

6.7 Additional information may be obtained by:

- review of the outcome of analysis from other samples that may have been taken from related water supply areas at a similar time to the original sample
- taking a sample prior to and after disinfection of the consumer tap
- taking a swab sample from the surfaces of the tap that come in contact with the water supply

6.8 The outcome of the further analysis provides important information on the likelihood that the failure to achieve the prescribed concentration is attributable to the domestic distribution system. There is a strong indication that the failure is attributable to the domestic distribution system in any of the following circumstances:

- (i) the failure to meet the prescribed concentration recurs at the original consumer's sample tap but all other samples meet the relevant prescribed concentrations;
- (ii) the failure to meet the prescribed concentration recurs in a sample taken before disinfection of the original consumer's sample tap but a sample taken following disinfection meets the relevant prescribed concentrations and all other samples meet the relevant prescribed concentrations;
- (iii) the failure to meet the prescribed concentration does not recur at the original consumer's sample tap but Enterococci or *E coli* are recovered from a swab sample taken from the surfaces of the tap and all other samples meet the prescribed concentrations; or
- (iv) the exceedence is clearly attributable to an upstream device eg softener, filter or point of use treatment device or from some other unit connected to the domestic plumbing eg washing machine or dishwasher.

6.9 Where water companies can demonstrate that failures to meet the prescribed concentrations were likely to be attributable to the domestic distribution system then the individual results on the public record should be qualified by appropriate comments.

6.10 Failures to achieve the prescribed concentration for copper, lead and nickel at the consumer's tap are commonly associated with the domestic distribution system as the water interacts with copper or lead pipes (or solders) and brass fittings which contain nickel. The water company should investigate the extent of these interactions

by taking additional unflushed samples following defined periods of stagnation and from nearby properties.

- 6.11 Failure to achieve the prescribed concentration for copper may occur in houses with new copper plumbing or where a significant amount of copper pipe has been replaced. Following a failure to achieve the prescribed concentration for copper, the domestic distribution system should be inspected to ensure that it meets the requirements of the Water Supply (Water Fittings) Regulations 1999.
- 6.12 Unless the water company can demonstrate that the failure to achieve the prescribed concentration for copper or lead was due to exceptional circumstances and was therefore unlikely to recur, regulation 17(9) requires the water company to modify or replace its pipes or fittings that have potential for contributing to copper or lead in the water supplied to the premises. In addition to these requirements, Regulation 30 contains additional requirements regarding lead pipe replacement following a request from the consumer.

### **Regulation 17(6) - Notification to consumers**

#### *Notices to consumers*

- 6.13 Regulation 17(6) requires a water company who has identified by its investigation that a failure is due to the domestic distribution system or to the maintenance of that system to notify affected consumers in writing of the nature of the failure and to relay steps (if any) that the water company or health authorities consider it desirable for the consumers to take in the interests of their health. Water companies should provide appropriate technical advice and may refer consumers to their Local Authority Environmental Health Department or health authorities for advice on health matters.
- 6.14 The notice from the water company should inform the consumer in simple layman's terms:
  - (i) the parameter that has failed;
  - (ii) the concentration or value of that parameter in the sample taken from the consumers' premises;
  - (iii) the prescribed concentration or value of that parameter;
  - (iv) the significance of the failure (eg if the water company considers that advice on health matters should be sought); and
  - (v) the reason for the failure.
- 6.15 The notice must also inform the consumer of the steps he/she should take. These steps will depend on the nature of the parameter and the cause and extent of the failure. Examples of the steps that the water company may consider are:
  - (i) **failures of microbiological parameters** – advise boiling water for drinking and food preparation pending investigation of the problem – a plumbing inspection may assist in the investigation - where the failure is associated with an individual fitting advise repair or replacement of the pipework or fitting causing the problem
  - (ii) **failures of the lead parameter (or other plumbing metals)** – advise drawing off the water standing in the pipework and using for purposes other than drinking or food preparation – advise consideration of replacing the pipework within the premises contributing to the failure

- (iii) **failures of other parameters** are likely to be caused by ingress to the pipework within the consumer's premises (by permeation, leaking pipes or back siphonage) – advise where necessary and appropriate boiling water for drinking and food preparation or not to use water for drinking and food preparation – advise a plumbing inspection - where the failure is associated with an individual fitting advise repair or replacement of the pipework or fitting causing the problem.

### **Regulation 18 – Investigations: indicator parameters**

- 6.16 Regulation 18(1) requires a water company, when it has reason to believe that the water supplied does not meet the specification for indicator parameters, to investigate why the specifications were not met and, if the specification for coliform bacteria or the colony count parameter is not met, whether the cause was the domestic distribution system or the maintenance of that system or neither. Such an investigation must be carried out when a sample taken in accordance with the Regulations does not meet the specification for an indicator parameter. Investigation should also be carried out when an operational sample or a sample taken in respect of an incident or a consumer complaint does not meet the specification for an indicator parameter.
- 6.17 Regulation 18(2) requires the water company as soon as its investigations are complete to notify DWI of results of the investigations and whether the inability to meet the specification is likely to recur.
- 6.18 If a particular parameter for a particular water supply zone or group of water supply zones supplied by the same water treatment works does not meet the specification for indicator parameters, and the water company notifies DWI that it has not met the specification and the inability to meet it is likely to recur, then the water company need not investigate and notify on each subsequent occasion that the specification is not met, provided it is clear that the cause is the same and there are no changes in circumstances. If it is likely that the cause is different or there has been a change in circumstances the water company must carry out the investigations and the notification. This paragraph only applies to those indicator parameters that are unlikely to be affected by the domestic distribution system or the maintenance of that system – chloride, *Clostridium perfringens* (including spores), conductivity, sulphate, total indicative dose (for radioactivity), total organic carbon (TOC), tritium (for radioactivity) and turbidity.
- 6.19 All occasions when the specifications for the ammonium, coliform bacteria and colony counts parameters are not met at consumers' taps must be investigated, in particular to determine whether the inability to meet the specification is due to the domestic distribution system or the maintenance of that system. When it is due to the domestic distribution system the water company must notify the affected consumers and inform them of the nature of the problem and any steps that the water company or health authorities consider it desirable for the consumers to take in the interests of their health. Water companies should provide appropriate technical advice and may refer consumers to their Local Authority Environmental Health Department or health authorities for advice on health matters. For the microbiological parameters that advice could be to boil water for drinking and food preparation and to get a plumbing inspection to identify the cause of the problem and to rectify the cause.
- 6.20 The national dilution numbers standards of 3 for taste and for odour are action levels at which further work should be initiated to investigate the cause of the deterioration.

Where background levels of taste and odour are low and change in levels are small, use of the Standing Committee of Analyst's dilution number methods is appropriate. Most waters will exhibit no or very low taste and odour. Water companies should establish the baseline level of taste and odour in each distribution system, including where appropriate the seasonal variations. Dilution number methods are not a useful technique if a qualitative assessment of an unexpected odour is required. All taste and odour customer complaint samples should receive a qualitative taste and odour test and where appropriate, additional tests should be undertaken to characterise the intensity and / or source of the taste or odour.

### **Regulation 19 – Action by DWI**

- 6.21 Regulation 19(1) permits the Secretary of State (in practice DWI) to require water companies to seek an authorised departure following a non trivial failure in respect of a Schedule 1 parameter that is likely to recur. Authorised departures are not permitted for the *E.coli* and Enterococci parameters and the DWI will proceed with an enforcement order under Section 18 of the Water Industry Act following non trivial failures that are likely to recur.
- 6.22 DWI will proceed with an enforcement order where the extent of any failure of any other Schedule 1 parameter constitutes a potential danger to human health.
- 6.23 Regulation 19(4) permits the Secretary of State (in practice DWI) to require Water Companies to take steps following a notification from a water company (under regulation 18(2)) that there is a continued inability to meet the specification of an indicator parameter. Steps only need to be taken where the inability to meet the specification poses a risk to health.
- 6.24 Most indicator parameters do not have a direct influence on health but are included in the monitoring programme because they may indicate a problem or potential problem with the treatment or distribution of drinking water. In all cases exceedence of an indicator parameter value must be followed by an investigation by the water company. In many cases a change in the level of indicator parameter may be more significant than the exceedence of a particular value. In many cases the nature of the raw water source will influence the significance of changes and exceedences of indicator parameter's values.

#### **(i) Ammonium (specification: 0.50 mgNH<sub>4</sub>/l)**

The presence of ammonium in raw waters is usually associated with organic contamination (animal waste and sewage) of surface waters or from the desorption of ammonium within anaerobic groundwaters. The exceedence of the indicator value in treated waters usually indicates that treatment of anaerobic groundwater or contaminated surface water has failed. The presence of ammonium in raw water may also compromise the efficiency of chlorination and therefore investigations into the exceedence of the indicator parameter value should include checks to establish the adequacy of disinfection. Unpleasant tastes and odours may be associated with high concentrations of dichloramine and trichloramine that may be caused by high concentrations of ammonium. In some cases elevated concentrations of ammonium may be associated with cement-mortar pipe linings.

#### **(ii) Chloride (specification: 250 mgCl/l)**

The presence of chloride in raw waters results from diverse inputs which include leaching from soils, sewage or industrial discharges, run-off from de-icing and saline

intrusion. In the later two cases there is also an associated increase in the concentration of sodium. Increased chloride content may also increase the aggressivity of water. In rare cases increases in the concentration of chloride have been associated with contamination by sodium chloride used as a regenerant for the ion-exchange removal of nitrate. As the concentration of chloride increases above the indicator concentration it is likely that there will be an increasing detection of taste from consumers. Typical taste thresholds are between 250 and 300 mg/l.

(iii) ***Clostridium perfringens* including spores** (specification: 0/100ml)

*Clostridium perfringens* are commonly found in human and animal faeces. As *Cl. perfringens* is generally present in faeces in much lower numbers than *E. coli* and Enterococci, it is less sensitive as an indicator of faecal contamination. The spores of *Cl. perfringens* are capable of surviving for significantly longer periods than vegetative bacteria such as coliforms or Enterococci. *Cl. perfringens* are removed from water by coagulation and filtration, but the spores of these bacteria can be resistant to chlorine at the concentrations normally used in water treatment. Low numbers may occasionally occur in water supplies, but their presence (in the absence of other faecal indicators) do not represent a risk to health. The main value of monitoring for *Cl. perfringens* at a point where the water leaves the water treatment works is to assess the efficiency of the treatment process. The presence of *Cl. perfringens* in treated water derived from groundwaters could indicate bacteriological contamination of the source. A change in the number of *Cl. perfringens* in treated water against the normal range for that supply is more significant than the exceedence of a particular value. Investigations into the exceedence of the indicator value should include checks to establish the quality of the source and the adequacy of treatment.

(iv) **Coliform bacteria** (specification: 0/100ml)

Coliform bacteria are a diverse group which are known to be present in soil, environmental waters and other environmental materials. Some members are also capable of growth in nutrient rich water and biofilms. As a result they are not considered to be specific indicators of faecal contamination. A few members of the coliform group can be associated with human infection as opportunistic pathogens or as hospital acquired infections. Whenever coliform bacteria are isolated from a drinking water supply investigations need to be carried out to establish the source of contamination. Coliform bacteria detected from samples taken within consumers' premises may be associated with the domestic distribution systems such as kitchen taps and sinks. Other potential sources of coliform bacteria in water supplies are sub-optimal operation of water treatment processes or ingress of contamination from breaches in the integrity of the distribution system (via hatches on service reservoirs, air valves, stop valves, cross connections and backsiphonage). In some cases additional information on the identity of the species of coliform bacteria present may prove useful in determining the sources and significance of the coliforms detected. Low numbers may occasionally occur in water supplies, but their presence (in the absence of other faecal indicators) do not represent a risk to health.

(v) **Colony counts** (specification: no abnormal change)

Colony counts are enumerations of the general population of heterotrophic bacteria present in a water supply. In environmental waters these represent bacteria whose natural habitat is the water environment or those that may have been washed from soil or vegetation. It is well recognised that only a small fraction of the viable heterotrophic bacteria population is estimated by enumeration on nutrient rich media

with incubation at 22°C and 37 °C. However, monitoring of water supplies for colony count bacteria can be useful for monitoring trends in water quality and detecting potential sudden deterioration in water quality. The colony count at 22°C generally represent those bacteria naturally present in water and are not of sanitary significance. They may, however, be of greater relevance to the food and drinks industries where high numbers may impact on the quality of products. An increase in the colony count at 37°C can be a sensitive indicator of ingress and further investigations should be undertaken to establish the source. Colony counts may be useful in assessing the efficiency of water treatment and the cleanliness and integrity of the distribution system. In all cases the value of monitoring is to establish data which characterises a water supply in terms of seasonal and longer term changes. Drinking water supplies derived from surface waters tend to support higher numbers of heterotrophic bacteria than those derived from groundwater sources. The onset of significant change in colony count results against the normal range established for that water supply is much more significant than the absolute values of individual results.

**(vi) Conductivity** (specification: 2500 µS/cm at 20°C)

Conductivity is a measure of the extent of dissolved inorganic ions that are present. It is a non specific measurement although a high value may indicate undesirably high concentration of ions. Increased values of conductivity in samples taken from consumer premises may indicate potential backflow or cross connections. A change in the concentration of conductivity against the normal range for that water supply is more significant than exceedence of a particular value. Further investigation and analysis is required to identify the predominant elements present. All of the significant individual elements have either standards or indicator values against which the need for action can be assessed.

**(vii) Hydrogen ion** (specification: pH 9.5)

This parameter has in addition a mandatory maximum value of pH 10.0. DWI considers that this is an appropriate action value. Although exceedence of the mandatory maximum value may not pose a direct risk to health, it may, depending on the buffering capacity of the water, increase the solubility of metals and may have an adverse impact on the aesthetic quality.

**(viii) Sulphate** (specification: 250 mgSO<sub>4</sub>/l)

High concentrations of sulphate may affect the taste of a water supply and there is also some evidence to suggest that it may have a laxative effect in vulnerable groups such as bottle fed infants. For these reasons DWI considers that water companies should take further action to investigate the origin of concentrations that exceed the indicator value.

**(ix) Total organic carbon** (specification: no abnormal change)

Total organic carbon is a non specific index of the organic material in a water supply. The significance of an increase in the concentration of total organic carbon will require further investigation. In some cases the increase may be associated with increases in the concentration of assimilable organic carbon. As assimilable organic carbon provides a potential nutrient source for bacteria water companies should investigate whether there is increased potential for the growth of biofilms.

**(x) Total indicative dose** (for radioactivity, specification: 0.10 mSv/year)

Where monitoring is being undertaken the level of gross alpha activity should be assessed against a screening level of 0.1 Bq/l and the level of gross beta activity assessed against a screening level of 1 Bq/l. If either screening value is exceeded additional analysis should be undertaken to establish which radionuclides are present. The range of radionuclides analysed should take into account relevant information on potential sources. The total indicative dose (TID) is then calculated from the individual isotope concentrations excluding any activity from tritium, potassium-40, radon and radon decay products. If the TID exceeds the indicator value of 0.10 mSv/year appropriate medical advice should be sought. The specification for total indicative dose is expressed in terms of the dose over a year. In interpreting the results of radioactivity monitoring it is necessary to take account of the variability in activity levels over time. Some water sources are likely to show seasonal variation due to natural processes. In addition, any short term increase in radionuclides that may result from radiological incidents should be assessed against guidance for food and liquids within guidance published by the former Department of the Environment (Civil Emergencies involving radioactive substances). See also paragraphs 4.17 – 4.30 and Appendix 4.

**(xi) Tritium** (specification: 100 Bq/l)

Tritium is naturally present in the environment but only at very low concentrations. Tritium can also be an indication of contamination from artificial sources and water companies should take actions to investigate the source of any exceedence of the indicator value. If the indicator value is exceeded additional analysis should be undertaken to establish which isotopes are present and the total indicative dose calculated from the individual isotope concentrations. If the total indicative dose exceeds the indicator value of 0.10 mSv/year appropriate medical advice should be sought. The specification for total indicative dose is expressed in terms of the dose over a year. In interpreting the results of radioactivity monitoring it is necessary to take account of the variability in activity levels over time. Some water sources are likely to show seasonal variation due to natural processes. In addition any short term increase in radionuclides that may result from radiological incidents should be assessed against guidance for food and liquids within guidance published by the former Department of the Environment (Civil Emergencies involving radioactive substances). See also paragraphs 4.17 – 4.30 and Appendix 4.

**(xii) Turbidity** (specification: 1 NTU)

The indicator value only applies at the treatment works. For this parameter there is in addition a mandatory maximum value of 4 NTU that applies at the consumers' tap. Exceedence of the indicator parameter value does not represent a direct risk to human health. Significant increase in the level of turbidity may compromise the effectiveness of disinfection. The World Health Organisation has issued guidance on the level of turbidity required to allow satisfactory disinfection. The importance of optimising the operation of water treatment works to effectively remove *Cryptosporidium* oocysts has been identified by the Expert Groups on *Cryptosporidium* in water supplies. An important element of this is controlling the effectiveness of particle removal by reference to the turbidity of filtered and final waters. DWI considers that any exceedence of the indicator value at a treatment

works should initiate an investigation into the cause in line with the recommendations in the reports of the Expert Groups on Cryptosporidium in water supplies.

- 6.25 A summary of investigations in respect of indicator parameters is given in Appendix 3.

**Regulation 20 – Authorisations of a temporary supply of water that is not wholesome**

- 6.26 Regulation 20 allows the Secretary of State to authorise a departure from the provisions of Part III of the Regulations upon written request of a water company. Authorised departures are only applicable for Schedule 1 parameters and will only be granted where the extent of the departure does not constitute a risk to human health.
- 6.27 The information that shall be provided with an application for an authorised departure is detailed in regulation 20(3). The application must be copied to every appropriate local authority, health authority and relevant Ofwat customer service committee, who have 30 days to make any representations on the application.
- 6.28 Where the Secretary of State (in practice the DWI) considers that the failure to meet the prescribed concentration is trivial and that the PCV will be met within 30 days a shortened application as specified in regulation 21(4) is required.
- 6.29 An authorised departure may be granted for a maximum of three years and in each case will specify the extent to which any parameter may depart from the PCV specified in Schedule 1. Where the Secretary of State (in practice DWI) considers that it is not possible to restore a wholesome water supply within three years water companies are required to apply for a further departure. DWI pro-forma for applications and authorisations for authorised departures have been provided with Information Letters.

## **PART VII      WATER TREATMENT**

### **Regulation 25 - Interpretation**

- 7.1 The Interpretation confirms that “surface water” does not include water from a spring. In the context of Regulation 26 a spring is regarded as underground water arising at the surface, under its own head, at the outcrop of the junction between impermeable and permeable strata. The quality of water from springs can be variable. Water derived from springs that issue from deep-seated aquifers can be of good quality, whilst water arising from perched water tables or supported by fissure flows is more variable.

### **Regulation 27 - Risk assessment for *Cryptosporidium***

- 7.2 Regulation 27 introduces a requirement to undertake a risk assessment at any treatment works which is intended to be used to supply water for regulation 4(1) purposes. The risk assessment should be undertaken according to the Guidance on assessing the risk from *Cryptosporidium* oocysts in treated water supplies to satisfy the former Water Supply (Water Quality) (Amendment) Regulations 1999.

### **Regulation 28 - Procedure following risk assessment, and prohibition of supply**

- 7.3 Regulation 28 details the procedures following the risk assessment. Should the Secretary of State (in practice the DWI) consider the risk assessment unsatisfactory the water company shall be notified and required to submit a further risk assessment report by a specified date. Where the risk assessment for the treatment works establishes no significant risk from *Cryptosporidium* the water company shall be notified that there is no need to meet the requirements of regulation 29. Where the risk assessment for the treatment works establishes a significant risk from *Cryptosporidium* the water company is required to submit an estimate of the earliest time that the requirements of regulation 29 can be met.

### **Regulation 29 - Treatment for *Cryptosporidium***

- 7.4 Regulation 29 describes the monitoring requirements to establish whether the treatment standard is being met. Details of the approved collection devices, approved sampling equipment, approved analysis and approved laboratories are given in the Standard Operating Protocols:

- Standard Operating Protocol for the Monitoring of *Cryptosporidium* Oocysts in Treated Water Supplies - Part 1 Sampling and Transportation of Samples (Revision June 2003)
- Standard Operating Protocol for the Monitoring of *Cryptosporidium* Oocysts in Treated Water Supplies - Part 2 Laboratory and Analytical Procedures (Revision July 2003)
- Standard Operating Protocol for the Monitoring of *Cryptosporidium* Oocysts in Treated Water Supplies - Part 3 Validation of New Methods or parts of Methods for sampling and Analysis (Revision June 1999)
- List of Laboratories approved to undertake analysis according to Part 2 and Part 3 of the Protocol

- 7.5 The Standard Operating Protocols require water companies to notify the DWI of results and circumstances where monitoring could not be completed. Detailed guidance on the requirements for notification have been issued in Information Letters 10/1999, 4/2000, 10/2000, 13/2000, 28/2000, 8/2001 and 12/2002.

### **Regulation 30 - Contamination from pipes**

- 7.6 Regulation 30 deals with contamination of the water supply by copper or lead as a result of the supply and domestic pipework. Further guidance on the way in which Water Companies should develop their plumbosolvency (and cuprosolvency if appropriate) treatment and control strategies has been provided in Information Letters 12/2000 and 3/2001. The risk (the prescribed risk) relates to the supply of water to any individual premises and arises when copper or lead is the major component of the service pipe.
- 7.7 Regulation 30(4) requires water companies to modify or replace their part of any lead service pipe when it has reason to believe that the concentration of lead at the consumer's tap exceeds 10 µg/l. The water company is required to replace their part of the pipe when the owner intends to replace his own part of the service pipe and the owner has made a written request to the water company to replace its part.

### **Further guidance on the lead parameter**

- 7.8 Regulation 17(9) applies to failure of the lead standard in force at that time. On that basis the trigger for action under this Regulation relates to 25µg Pb/l until 25 December 2013 at which time the trigger will reduce to 10µg Pb/l.
- 7.9 Any compliance, random daytime survey or samples taken specifically at the request of consumers, but excluding samples taken for research or operational purposes particularly those involving stagnation sampling techniques, which exceeds 25µg Pb/l at a consumer's tap should trigger the obligation to replace lead communication pipes.
- 7.10 Where a relevant sample is taken which triggers a potential obligation under regulation 17(9) a simple follow up investigation should occur. This would include as a minimum:
- (i) a check to see whether a company lead communication pipe is present;
  - (ii) identification of any special factors eg very long consumer lead pipe; and
  - (iii) a repeat sample based on either random daytime sampling or 30 minutes stagnation as deemed appropriate in the circumstances.
- 7.11 If the second sample also exceeds 25µg Pb/l or there are particular high risk factors which mean that 25µg Pb/l is likely to be exceeded in the future then the water company will undertake the following actions:
- (i) institute a replacement of its part of the lead service pipe; and
  - (ii) notify the customer of the situation in writing.
- 7.12 Immediate action will not be required if the lead communication pipe to that property is scheduled to be replaced as part of an agreed strategic programme within the next three months or where a mains rehabilitation programme is planned within the next three months and any lead communication pipes would be replaced as part of that work.

## **Regulation 31 - Application and introduction of substances and products**

- 7.13 Regulation 31 specifies the circumstances in which water companies may apply or introduce substances or products into water supplied for drinking, washing, cooking or food preparation. Paragraph (3) and (3)(a) refer to appropriate CE marking and other appropriate European technical specifications. Paragraph (3)(b) lists equivalent national measures that may be considered in the absence of European specifications. Paragraph (3)(i) requires water companies to adhere to national conditions of use that apply to substances and products applied or introduced under (3)(a) and (b). Paragraph (3)(ii) confirms that the UK will comply with the requirements of the 98/34/EC Directive on the notification of national conditions of use as new technical requirements.
- 7.14 Paragraph (4)(a) provides for use of substances and products approved by the Secretary of State and paragraph (2) makes it clear that this approval route is available only in the absence of CE marking or appropriate European or national specifications. Provision is made for conditions of approval to be attached to the Secretary of State's approval. Paragraph (4)(b) provides for the Secretary of State to exercise his discretion not to require approval of a substance or a product that is considered to be unlikely to affect adversely the quality of the water supplied. Paragraph (4)(c) provides for authorisation by the Secretary of State of the use of unapproved substances or products, in accordance with a previously notified programme of testing or research. The length of the period of testing or research is subject to the 12-month limit, or other notified period, set out in paragraph (7) of Regulation 31.
- 7.15 Paragraph (5) authorises applications for approval to be made by any person. Paragraph (6) provides for variation or revocation of an approval, subject to the requirements of paragraphs (10) and (11) in respect of the giving of notice to those affected by the variation or revocation. Paragraph (8) provides for the Secretary of State to prohibit the use of any substance or product which water companies would otherwise be authorised to use, subject to the requirements to give notice as set out in paragraphs (10) and (11). Paragraph (12) requires the Secretary of State, at least once in each year, to issue a list of all substances and products for which approval has been granted, refused, modified, revoked or prohibited.

## **Regulation 32 - Use of Processes**

- 7.16 Regulation 32 provides for the Secretary of State to give notice to a water company, requiring them to make an application for approval of any process. The notice may also prohibit use of the process for a specified period. Regulation 32 also provides for attaching conditions to an approval and for revocation of approval and modification of conditions of approval and publication of a list of approved processes. Provisions equivalent to those prescribed in regulation 31 in respect of giving notice apply to regulation 32.
- 7.17 Under the offences provisions of regulation 33, penalties are specified for contravention of: regulation 31(2) (use of unapproved products); 31(8) (Contravention of a prohibition notice); 32(1) (Use of a process in contravention of a prohibition notice); and 32(2) (failure to observe conditions of approval of a process). Regulation 33 provides also for prosecution of anyone providing false information in support of an application for approval, subject to the consent of the Secretary of State or the Director of Public Prosecutions.

## **Guidance on specific issues**

### **Regulation 31(3) Acceptable technical specifications**

- 7.18 For the time being, only the European standards for drinking water treatment chemicals (published as BS EN standards) satisfy the harmonised standard criteria of regulation 31(3). A full listing of BS EN standards and the relevant national conditions of use, are given in the Secretary of State's List of approved products. The list is posted on the DWI website ([www.dwi.gov.uk/](http://www.dwi.gov.uk/)).
- 7.19 The European Commission's European Acceptance Scheme (EAS) initiative will lead to production of harmonised standards for construction products used in contact with drinking water. However, the EAS is unlikely to be implemented before 2007. There are currently no European Technical Approvals applicable to drinking water construction products and none are expected to become available in the foreseeable future.
- 7.20 When assessing whether an appropriate British Standard or national standard of an EAS State is acceptable under regulation 31 (3) (b), water companies must seek confirmation that:
- (i) the test requirements include an assessment of potential adverse effects on water quality; and
  - (ii) the test conditions represent the worst case conditions under which the product will be used; and
  - (iii) the test parameters include relevant Drinking Water Directive parameters and parameters derived from the product; and
  - (iv) a toxicological assessment of the leaching test data was carried out.

### **Regulation 34(1)(c) Requirements within the meaning of Council Directive 98/34/EC**

- 7.21 These requirements are the national conditions of use that affect the supplier or manufacturer of the product, as well as the water company eg restrictions on the purity of a product. Before these can be imposed as national conditions of use, they must be notified to the European Commission as a new technical requirement, under the provisions of the 98/34/EC Directive. The Directive requires Member States to notify technical regulations to the Commission in draft. They must then observe a standstill period of at least three months before adopting the regulation, in order to allow other Member States and the Commission an opportunity to raise concerns about potential barriers to trade. In this respect, national conditions of use that prescribe only dosing concentrations are not notified as they do not require any action on the part of the manufacturer or supplier.

### **Regulation 31(4)(a) Substances or products unlikely to affect adversely the quality of water supplied**

- 7.22 Water companies should assume that, in the absence of appropriate European or national specifications that satisfy the requirements of Regulation 31 (3), the approval of the Secretary of State will continue to be required for products used in contact with water in the following circumstances:

- (i) all chemicals used in the treatment of drinking water or used in association with the operation of water treatment processes;
- (ii) filtration and ion exchange media, membrane filtration and electrodialysis systems;
- (iii) all systems used to generate disinfectants *in-situ*;
- (iv) all construction products used in water treatment processes, including pipelines and water storage installations;
- (v) all *in-situ* applied repair materials;
- (vi) all construction products and coatings of construction products used in water supply pipelines (including raw water pipelines);
- (vii) all construction products and coatings of construction products used in treated and raw water storage installations; and
- (viii) all water retaining vessels and pipework used in the provision of water for emergency purposes.

- 7.23 Water companies should continue to consult the CPP Secretariat over the test requirements for any product that offers low surface areas and/or transient contact times.
- 7.24 Water companies should note that the provisions of regulation 25 (1)(b) of the 1989 Regulations, whereby water companies could use un-approved products at their own discretion, are not available in the 2000 Regulations.
- 7.25 Applications for approval by the Secretary of State should be directed to The Technical Secretary, Committee for Products and Processes, 2/E5 Ashdown House, 123 Victoria Street, London SW1E 6DE (e-mail:[ccp@defra.gsi.gov.uk](mailto:ccp@defra.gsi.gov.uk)). Information about the approval scheme can be found on the DWI website: [www.dwi.gov.uk/cpp](http://www.dwi.gov.uk/cpp)

### **Introduction for the purposes of testing or research**

- 7.26 When giving notice to the Secretary of State under regulation 31(4)(c) of intention to use a substance or product for the purposes of testing or research, water companies must provide the information set out in the following paragraphs.

#### *Justification for testing or research*

- 7.27 Water companies, manufacturers or suppliers may wish to carry out tests to establish the performance of an unapproved substance or product. The justification should provide details of the product(s) to be tested and a statement explaining why a period of unapproved use is required.

#### *Scale of experimental plant*

- 7.28 The water company must describe the location and specification for the water treatment equipment that will be used. Testing and research should not be carried out at full scale. It may be appropriate to restrict the programme to designated units in a full-scale plant, or to a pilot plant. It should be possible quickly to shut down the experimental plant or to divert the treated water to waste. It follows therefore that the

quantity of water produced in the experimental plant should not be critical to the overall demand in the area.

*Monitoring programme and reporting*

- 7.24 The water company must provide a detailed monitoring programme with clearly stated objectives covering a finite period. The monitoring programme must incorporate measurements of appropriate sensitivity and frequency that would permit the detection of an adverse effect on water quality arising from the use of the substance or product that is being tested. The monitoring programme must include unambiguous statements of what constitutes an adverse effect and describe the action that should be taken in the event of detection of any adverse effect. A log must be kept of the operation of the experimental plant and a report, describing the tests carried out and any conclusions drawn, must be prepared at the end of the monitoring period.

*Management of testing and research*

- 7.29 Water companies must provide full details of the arrangements for management of the programme of testing and research. A senior officer with appropriate experience and qualifications must manage the programme. Designated staff who are competent to perform their respective tasks must carry out all experimental work. The responsibilities of all staff involved in the programme must be clearly stated.

**No contact or trivial or transient contact with water**

- 7.30 Substances and products used in the treatment and distribution of public water supplies which are (i) not in contact with water; or (ii) used in situations where contact with water is transient or trivial; or (iii) only come into contact with water as a result of an accident or equipment failure fall outside the scope of regulation 31. Approval by the Secretary of State is not required in these circumstances.
- 7.31 Examples of (i) include: roofing membranes and tanks and pipework used to store and transport water treatment chemicals. Examples of (ii) include pipe jointing lubricants and formwork release agents. Examples of (iii) include pump lubricants or release of substances from damaged probe sensors.

## **PART VIII      RECORDS AND INFORMATION**

### **Regulation 34 - Maintenance of records**

- 8.1 Regulation 34 details the information to be provided in the public record. The public record, which may be in hard copy or electronic format, should be made available to the public within at least one of the water company's offices at reasonable office hours. The entries for the results of compliance analysis should be reported in the units of the Regulations.

### **Regulation 35 - Provision of information**

- 8.2 Regulation 35 specifies the information to be supplied to the local authorities. The regulation requires water companies to provide information on the results of analysis of samples taken from water treatment works, service reservoirs, supply points and water supply zones that relate to the quality of water supplied to premises in the local authority's area.
- 8.3 Information should be provided as a summary for each water treatment works, service reservoir, supply point and water supply zone. The format of information is not specified and water companies are encouraged to liaise with their respective local authorities to develop systems of reporting that are acceptable. It is envisaged that water companies may agree to supply the information in either hard copy or an agreed electronic format. Details of the type of information required by Regulation 35 are summarised in Appendix 5.
- 8.4 In order to facilitate the interpretation of the information provided for supply points the water company should provide details of the relationships between the supply points and the water supply zones to which they relate.
- 8.5 The need to report the mean concentrations for microbiological parameters has not been retained in the Regulations. This would facilitate the use and reporting of presence/absence testing for microbiological parameters at weekends and bank holidays.

### **Regulation 36 - Publication of information**

- 8.6 Regulation 36 specifies the information to be provided in the annual report. The format of the report is not specified to allow Water Companies to adopt reporting formats that are readily informative. DWI considers that making the report accessible in an electronic format may fulfil the requirement for publication. The regulation also requires copies of the report to be sent to the relevant local authorities. DWI considers that copies of the report could be sent in electronic format.
- 8.7 In contrast to the information to be provided to local authorities the annual report is a summary of the total numbers of samples taken at all water treatment works, all service reservoirs, all supply points and all water supply zones. It should also include the number and percentage of samples that fail to meet the relevant PCV and the value specified in an authorised departure. In the case of indicator parameters the number of samples that exceed the indicator parameter value shall be recorded. Details of the type of information required by regulation 36 is summarised in Appendix 6.

## APPENDIX 1

### REGULATION 16 – ANALYSIS OF SAMPLES

#### **A1 Training of analysts**

- A1.1 Water companies or their analytical contractor should produce a comprehensive analyst training manual and programme to cover all aspects of analysis.
- A1.2 Once trained, all analysts' performance should be monitored and subject to regular audit. Monitoring and audit procedures, and criteria for satisfactory performance and policy on retraining should be documented.
- A1.3 A training record should be produced for each analyst detailing the training given, with dates and assessment of competence, results of any audits, any retraining or further training given and any re-assessment of competence.

#### **A2 Suitability of equipment**

- A2.1 In addition to equipment being of the type specified in the analytical procedure, it must comply with each of the following requirements before it can be regarded as suitable for the purpose:
  - (i) located and used in appropriate conditions;
  - (ii) maintained according to the manufacturer's recommendations or auditable equivalent procedures;
  - (iii) have a current calibration that is both valid and traceable to national and international standards;
  - (iv) be used in accordance with the manufacturer's operating instructions or auditable equivalent procedures; and
  - (v) demonstrably comply with all system suitability and analytical quality control criteria.
- A2.2 General advice on calibration is given in 'Guidelines for Calibration in Laboratories' which is available on the DWI web site ([www.dwi.gov.uk](http://www.dwi.gov.uk)).
- A2.3 Sub-paragraph (e) of regulation 16(2) requires that all analysis, including field tests, must be subject to a system of analytical quality control (AQC) sufficient to demonstrate that the requirement of regulation 16(5) have been complied with for each analysis. For microbiological parameters either the specified method or an approved alternative must be used in conjunction with the practices and procedures given in 'The Microbiology of Drinking Water (2002)'.
- A2.4 Appropriate systems of AQC for all other parameters will include:
  - Performance testing of the analytical system;
  - Routine internal AQC; and
  - External AQC (proficiency testing), if a suitable scheme is available.

A2.5 Sub-paragraph (e)(ii) of regulation 16(2) requires that a laboratory's system of AQC is subject to independent checking by a person who has been approved by the Secretary of State for that purpose.

### **A3 Initial Performance testing**

- A3.1 Each laboratory or field testing organisation is required to have tested the performance of the analytical methods used for each parameter or each determined constituent of a parameter, and to have demonstrated that the system is capable of meeting the requirements set out in paragraph 16(5) and Schedule 4 before that system is used for routine analysis of compliance samples. Performance testing should cover the entire analytical procedure, including any sample preparation and concentration steps. Testing must be carried out in a manner emulating that used routinely, without taking special precautions which would not generally apply to achieve optimum performance.
- A3.2 An analytical method is the specific combination of laboratory, analysts, instrumentation and analytical procedure used to analyse the sample, including any sample preparation or pre-treatment steps. Provided all analysts have been trained to the same standard and their competence has been assessed using the same criteria they can be regarded as equivalent for the purposes of initial performance testing of the analytical method.
- A3.3 The analytical method should be subjected to testing of its trueness, precision and limit of detection, including spiking recovery and resilience against possible interferences. The minimum acceptable specifications for performance testing are given below. The design of tests and calculation of performance characteristics should be in accordance or consistent with the guidance given in 'A Manual of Analytical Quality Control for the Water Industry'(NS30).
- A3.4 A laboratory using an analytical method which is not referenced to a fully validated authoritative method will be expected to demonstrate that the method has been fully documented and tested to the standard currently expected of an authoritative reference method. It should demonstrate that the following have been established:
- (i) the required tolerances of all measurements undertaken within the method (volumes, temperatures, masses etc);
  - (ii) the forms of the determinand measured, including speciation;
  - (iii) the effect of interferences has been widely investigated and quantified; and
  - (iv) significant sources of error have been identified and adequate means of controlling them documented.
- A3.5 Further guidance is given in section 4 of NS30. In the past some reference methods may have been validated to a lower standard than is now required by bodies such as the Standing Committee of Analysts. The data available plus the body of experience of use of these methods should be assessed when deciding whether the methods are suitable.
- A3.6 For most parameters the minimum specification for the performance characteristics to be determined is as follows.

Estimate the within-laboratory total standard deviation of individual analytical results for blanks, standard solutions, samples and spiked samples on at least 5 separate days (further advice on number of batches and period of testing is given below). The number

of replicate determinations of each solution in each batch should be the same and not less than two. The trueness for standard solutions, mean spiking recovery and standard deviation of spiking recovery should also be determined.

- A3.7 The range of the standard solutions tested should include the regulatory prescribed concentration or value wherever possible, but in all cases the whole calibrated range of the method must be covered subject to allowance for ensuring that all measurements fall within the calibrated range. This implies that a minimum of two different standard solutions must be included in the performance tests. All standard solutions should be prepared immediately prior to analysis for each batch, either from the pure substance or a stock solution which is known to be stable for the period of the tests.
- A3.8 All estimates of standard deviation used to estimate limit of detection or precision, or used in significance tests must have at least 10 degrees of freedom.
- A3.9 The sample, or if necessary samples, and spiked sample(s) selected for use should represent the type or types of drinking water normally analysed. The same bulk sample(s) should be used throughout the tests. Samples should be spiked immediately before analysis for each batch. The spiking standard should either be known to be stable for the period of the tests or be prepared as for standard solutions.
- A3.10 Where there is a choice of key instruments, including electrodes and chromatographic columns, each combination used should be regarded as a separate analytical method. In such cases the following guidance is given.
- A3.11 For identical instruments full validation is required of each method except where the results of limited testing of the instruments under the conditions used in the analytical method have demonstrated that there is no statistically significant (at the 95% confidence level) difference in performance between the instruments, in which case only one method requires full validation. The tests should be performed on a minimum of five separate days and include the analysis of typical real samples and spiked samples. If the internal AQC record subsequently shows a significant difference in performance between methods each system should then be fully validated. Alternatively, independent data may be available to demonstrate the equivalence of items such as chromatographic columns.
- A3.12 For instruments which are not identical full validation is required for each analytical method.
- A3.13 Laboratories should note that 5 batches of duplicate analyses does not give 10 degrees of freedom. While many combinations of number and size of batch may give 10 degrees of freedom or more, a minimum of 11 batches is required to guarantee that number of degrees of freedom, irrespective of the number of replicates included in the batch. Laboratories are therefore strongly recommended to adopt 11 batches of duplicates as their minimum specification. The formula for calculating degrees of freedom is given on page 57 of NS30.
- A3.14 For methods where the discrimination of the method is insufficient to record values other than zero for most blank determinations the within-batch standard deviation of either the low standard or the total standard deviation of the sample may be used to calculate the limit of detection. Alternatively, a very low standard solution, at a concentration approximately two to three times the expected limit of detection when using the best currently available method, may be used as a surrogate blank. Some methods, particularly those involving simple titrations or the use of comparators, may be incapable

of measuring any within-batch differences. In such cases the limit of detection should be quoted as the lowest measurable concentration or value.

- A3.15 The bulk sample may not always be stable over the entire period of testing, resulting in an artificially high estimate of between-batch standard deviation. This instability may be recognised by a distinct trend in results for the sample over the period of testing and a between-batch standard deviation which, statistically, is significantly greater (at the 95% confidence level) than would be expected from the estimates obtained for the standard solutions. In such cases a surrogate between-batch standard deviation should be calculated using procedure (a) on page 53 of NS30. Where the instability is so great that the estimate of within-batch standard deviation is significantly affected it may be possible to improve stability by ageing of the sample. Where ageing is either impractical or ineffective in reducing sample instability sufficiently to avoid a statistically significant effect on the estimate of within-batch standard deviation, procedure (b) on pages 53 and 54 of NS30 should be used.
- A3.16 The period of testing should be continuous and not unduly long. Not more than 2 batches may be analysed on any one day. When 2 batches are analysed on the same day all instruments used should be shut down to overnight conditions, daily reagents freshly prepared and all test solutions freshly prepared between the first and second batches.
- A3.17 For physical parameters for which values are not truly additive spiking recovery tests may yield little useful information and need not be done. It is not possible to either analyse a blank or do spiking recovery tests for hydrogen ion. For these parameters the calibrated range (or ranges) must include the full range of values encountered and the PCV (the full PCV range for hydrogen ion), as samples cannot be diluted.
- A3.18 In the following paragraphs re-evaluation means the investigation of the analytical system and its performance to determine whether the most recent validation or revalidation of the analytical system remains appropriate. Re-evaluation may include, as necessary, assessment of the cumulative effect of minor changes to the analytical method, review of internal and external AQC and corrective action followed by limited testing to demonstrate that correct performance has been re-established.
- A3.19 In the following paragraphs revalidation means the redetermination of the performance characteristics of the analytical system as described above.
- A3.20 The performance characteristics of an analytical method should be revalidated whenever a significant change has occurred such as a change in:
- (i) the analytical procedure used;
  - (ii) the key equipment used;
  - (iii) the laboratory environment; or
  - (iv) change of staff carrying out the procedure. This does not include routine changes which normally occur within the laboratory which are supported by appropriate training and properly trained supervisors.
- A3.21 The significance of any change should be assessed by a competent analyst, and any decision that a change is not significant supported by the results of limited but adequate testing.

- A3.22 When a change of premises occurs it is not always possible to revalidate all analytical methods before they are used. In such cases it is essential that methods which on transfer also undergo a change of one of the types (i), (ii) and (iv) above are revalidated before they are used, as should those which are known to be susceptible to changes in laboratory environment eg ammonium and trihalomethanes. Other analytical methods should normally be revalidated within three months of relocation.
- A3.23 Analytical methods should also be re-evaluated and if necessary revalidated whenever the results of routine AQC (internal or external) indicate that a statistically significant deterioration in performance has occurred which cannot be corrected, or that there is a significant discontinuity in the routine AQC record, whether due to a failure to perform routine AQC or disuse of the analytical method. Laboratories may also wish to re-evaluate the performance characteristics whenever routine AQC indicates that a statistically significant improvement in performance has occurred. Statistical significance should normally be assessed at the 95% confidence level.
- A3.24 Analytical methods which are used infrequently should not require full revalidation when they are used provided a greater degree of internal AQC is employed than that recommended for routinely used systems. A suitable procedure is given in recommendation (iv) of the Harmonised Guidelines for Internal Quality Control in Analytical Chemistry Laboratories ISO/IUPAC/AOAC, Pure and Applied Chemistry, vol 67, No 4, pp 649-666, 1995 (The AQC Guidelines).
- A3.25 When an analytical method has been in continuous use for several years, typically between three and five years, without revalidation, the system should be re-evaluated, and the need for revalidation of the performance characteristics considered.

#### **A4 Routine Internal AQC**

- A4.1 As a minimum, the laboratory should use a control solution that contains a known concentration at or close to the PCV for each parameter or determined constituent of a parameter for each analytical method, except as provided for below. The term "close to the PCV" should be interpreted as meaning the PCV  $\pm$  25%. The PCV for a determined constituent of a parameter is the PCV for the parameter. The frequency of use of control solutions will vary according to the particular analytical technique used but normally between five and twenty percent of all samples analysed should be control solutions, subject to a minimum of one per batch of analyses for batches of less than 20 samples. All control solutions should be subject to the full analytical procedure that is used for analysing samples and analysed with each batch of analyses.
- A4.2 For permanent laboratory tests a "batch of analyses" should be regarded as a group of measurements or observations of standards, samples and/or control solutions which have been performed together in respect of all procedures, either simultaneously or sequentially, by the same analysts using the same reagents, equipment and calibration.
- A4.3 For field tests a "batch of analyses" should be regarded as a group of measurements or observations of standards, samples and/or control solutions which have been performed on the same day by the same analysts using the same reagents, equipment and calibration.
- A4.4 In the following cases the guidance on selection of control solutions given above is not appropriate:
- (i) the PCV represents a concentration or value outside the normal analytical range of a particular method;

- (ii) there is no PCV;
- (iii) the PCV is descriptive;
- (iv) the PCV is a minimum; or
- (v) the PCV is a range.

- A4.5 In these cases, as a minimum, a control solution with a known concentration or value within both the calibrated range of the method and the range of interest should be used.
- A4.6 When a wide range of concentrations or values is calibrated which includes the PCV but the overwhelming majority of drinking water samples have concentrations or values which are within a narrow band of the calibration range for which control at the PCV is inappropriate, as a minimum two control solutions should be used, one with a known concentration or value at or close to the PCV and the other with a known concentration or value within the range of interest.
- A4.7 As a minimum, all the results obtained from all control solutions should be used to plot, for each solution or calculated quality control characteristic, a Shewhart chart which is used to decide whether a method is in statistical control. When other types of chart are used, including those using statistics calculated from individual values, the laboratory or other organisation should demonstrate that its arrangements effect adequate statistical control over the systematic error, and both the within-batch and between-batch components of random error, though not necessarily as separate items.
- A4.8 Further guidance on the construction and use of control charts is given in NS30, the AQC Guidelines and "Guidance On The Interpretation Of Aspects Of Analytical Quality Control (AQC)" which is available from the Drinking Water Inspectorate.
- A4.9 The laboratory or other organisation should have properly documented policy and procedures for routine AQC that stipulate what action or actions should be followed when an out of control condition is shown to exist, include a definition of an out of control condition and detail the records to be made when such a condition exists. These documents should be consistent with the guidance given in the documents referenced above. The results of analyses obtained using a method not in statistical control should not be released except in exceptional circumstances, when each result so released should carry an appropriate commentary in all records and reports. The circumstances in which such results can be released should be fully documented and state that the cause of the out of control condition should first be identified and shown not to affect the results of analysis of samples intended for release.
- A4.10 The procedures should also include regular and frequent examination and review of all charts and include guidance for checking and investigating significant trends or changes in either random or systematic error, and for correct operation of the chart. The minimum examination and review periods for each chart should depend on the frequency with which datum points are produced but should not be less frequent than monthly for examination and annually for review. The examination and review should be carried out by a suitably qualified and competent person who is not directly involved in the analysis, such as the laboratory quality manager. There should be appropriate rules for assessing revised control limits.

## **A5 External AQC**

- A5.1 The laboratory should participate in an appropriate external AQC scheme for each parameter or determined constituent of a parameter for which an appropriate scheme is available. The laboratory should also have a properly documented procedure for investigating and recording all failures notified by the organiser of a scheme.
- A5.2 Guidance on the suitability of a scheme is given in "The International Harmonised Protocol for the Proficiency Testing of (Chemical) Analytical Laboratories" M Thompson, R Wood, Journal of AOAC International, Vol 76, No 4, 1993.
- A5.3 In line with the recommendations of this document laboratories are recommended to participate in schemes distributing drinking water samples of appropriate matrix and which conform to the relevant parts of the protocol. Samples should contain or be spiked with concentrations of interest (approximate range PCV/10 to twice the PCV) and with appropriate speciation where this is of interest. When, in respect of any parameter, a laboratory participates only in schemes which do not meet all the recommended criteria it will be expected to demonstrate that it is participating in the most appropriate scheme currently available.

## **A6 Regulation 16(3)**

- A6.1 This regulation includes any organisation or person carrying out regulatory analysis in the definition of a laboratory. This includes all analyses carried out as field tests.

## **A7 Regulation 16(4) Retention of records**

- A7.1 This regulation requires a water company to make and retain all records necessary to establish that all the requirements of regulation 16 have been complied with in respect of each analysis carried out.
- A7.2 The records required include:
- (i) instrument installation, commissioning, maintenance and repair records, including any instrument log or diary;
  - (ii) basic calibration records (including proof of traceability), system suitability checks and any other record necessary to demonstrate the suitability of any equipment used at the time of the analysis;
  - (iii) the analytical procedure used;
  - (iv) method performance testing data, including raw data and a full record of any re-evaluation of the method;
  - (v) routine internal and external AQC data, including charts, investigations of out of control conditions and corrective action; and
  - (vi) raw data for the whole analytical run.
- A7.3 Items (i) and (ii) above should be retained for not less than three years after the equipment has been decommissioned and disposed of. Calibration records should be

retained for not less than three years after either disposal of the equipment or disposal of the calibration item, whichever is the longer.

A7.4 Items (iii) and (iv) above should be retained for not less than three years after the last analysis to which they relate.

A7.5 Items (v) and (vi) above should be retained for not less than three years.

## **A8 Regulation 16(5)**

A8.1 This regulation sets the required standard for quality of analysis or, in the case of microbiological parameters, the method to be used.

### **Microbiological parameters**

A8.2 Sub-paragraph (a) requires that the methods specified in column (2) of Table A1 in Schedule 4 must be used, unless an alternative has been approved. See regulations 16(7) to 16(11) below.

### **Hydrogen ion**

A8.3 All pH measurements must have a trueness of 0.2 pH units and a precision of 0.2 pH units. Suitability of any analytical method used must be established before it is used to analyse samples. See *Initial performance testing* above. On commencement of use, the analytical method must then be continuously subject to routine internal and external AQC. See *Routine Internal AQC* and *External AQC* above.

### **Odour and Taste**

A8.4 A method with a precision of 1 dilution number at 25°C must be used.

A8.5 Methods A2 and B2 respectively in the publication The Determination of Taste and Odour in Potable Waters 1994 in the series Methods for the Examination of Waters and Associated Materials (HMSO) should be used, omitting the intermediate screening steps in A2.8.2 and B.2.9.2. Performance characteristics cannot be determined for these parameters, nor is there currently available a suitable scheme of external AQC. One sample, which is expected to have a dilution number greater than zero, should be analysed in duplicate with each batch of samples put through the full procedure. The difference between the two results should be plotted on a control chart and used to provide information on precision of analysis of samples. All out of control conditions should be investigated and appropriate action taken. Further advice on the use of difference control charts is given in section 5.3.3 (pages 59 to 70) of NS30.

### **Parameters with no PCV or a descriptive PCV only**

A8.6 The parameters residual disinfectant (free and/or total chlorine) and total organic carbon have no numerical value for the PCV and therefore do not appear in Table 2 in Schedule 4. The general guidance given below for all other parameters is appropriate, but satisfactory target values for limit of detection, precision and trueness need to be set by the laboratory. This should be done on the basis of fitness for purpose. Unless the water company is able to demonstrate that less stringent targets are appropriate the target values given below will be regarded as describing fitness for purpose for these parameters.

**(i) Residual Disinfectant:**

Trueness	The greater of 10% of the result or 0.05 mg Cl/l
Precision	The greater of 10% of the result or 0.05 mg Cl/l
Limit of Detection	0.05 mg Cl/l or the minimum concentration specified as either a target value or an action level at any of the water company's treatment works or in its distribution system, whichever is the lower concentration.

**(ii) Total organic carbon (TOC)**

Trueness	The greater of 10% of the result or 0.25 mg C/l
Precision	The greater of 10% of the result or 0.25 mg C/l
Limit of Detection	0.5 mg C/l

**All other parameters**

- A8.7 The performance requirements are given in Table A2 in Schedule 4 in terms of the maximum permitted deviation of the method for trueness and precision and the maximum value for the limit of detection. These terms are defined in regulation 16(6). For the purposes of these regulations, the precision quoted is numerically equal to twice the total within laboratory standard deviation of individual results.
- A8.8 Methods that measure the parameter as defined and are capable of achieving the stated performance should be selected. Due regard must be given to the effect of interferences. In general, the methods published by the Standing Committee of Analysts in the series 'Methods for the Examination of Waters and Associated Materials' will be capable of the required performance, but laboratories should ascertain this before using any particular method.
- A8.9 A laboratory using an analytical method which is not referenced to a fully validated authoritative method will be expected to demonstrate that the method has been fully documented and tested to the standard currently expected of an authoritative reference method. It should demonstrate that the following have been established:
- (i) the required tolerances of all measurements undertaken within the method (volumes, temperatures, masses etc);
  - (ii) the forms of the determinand measured, including speciation;
  - (iii) the effect of interferences has been widely investigated and quantified; and
  - (iv) significant sources of error have been identified and adequate means of controlling them documented.
- A8.10 Further guidance is given in section 4 (pages 31 to 48) of NS30. In the past some reference methods may have been validated to a lower standard than is now required by bodies such as the Standing Committee of Analysts. The data available plus the body of experience of use of these methods should be assessed when deciding whether these methods are suitable.
- A8.11 Table A2 in Schedule 4 only specifies precision and trueness at the PCV. At other concentrations or values the requirement is either the percentage figure given in Table

A2 or one half of the value or concentration represented by that percentage figure at the PCV, whichever is the larger.

- A8.12 For example, for aluminium the trueness and precision requirements are 10% at the PCV ( $200 \mu\text{g/l}$ ). This equates to an absolute value of  $20 \mu\text{g/l}$  at the PCV. The target for concentrations less than  $100 \mu\text{g/l}$  (one half of the PCV) is one half of this,  $10 \mu\text{g/l}$  (standard deviation  $5 \mu\text{g/l}$ ). For all concentrations above  $100 \mu\text{g/l}$  the target is 10% of the result (standard deviation 5%). At one half of the PCV the target is the same whichever way it is calculated. A worked example for bromate is given below.

<b>Worked example for the bromate parameter</b>
<b>Limit of Detection</b>
Target 25% of PCV ie for bromate $2.5 \mu\text{g/l}$
Calculated as $5 \times$ within batch SD for blank <u>or</u> $3 \times$ within batch SD of a natural sample
<b>Precision</b>
Target the greater of 25% of <u>mean result</u> or 25% of $0.5 \times$ PCV ie for bromate 25% of mean or $1.25 \mu\text{g/l}$
This applies to all solutions
<b>Trueness</b>
<b>(i) Standards</b>
Greater of 25% of true value or absolute target of 25% of $0.5 \times$ PCV ie for bromate 25% of prepared value or $1.25 \mu\text{g/l}$
<b>(ii) Natural samples</b>
Not applicable
<b>(iii) Spiked natural samples</b>
Mean recovery of spike the greater of 25% of added spike or 25% of $0.5 \times$ PCV ie for bromate 25% of added spike or $1.25 \mu\text{g/l}$

- A8.13 The suitability of any analytical system used must be established before it is used to analyse samples. See *Initial performance testing* above. On commencement of use, the analytical system must then be continuously subject to routine internal and external AQC. See *Routine Internal AQC* and *External AQC* above.
- A8.14 Performance of a method is satisfactory if either all the relevant criteria are met for all solutions or any difference between the target and the estimate is not significant at the 95% confidence interval.

## **A9 Regulation 16(6)**

- A9.1 This regulation defines the terms 'limit of detection', 'precision' and 'trueness'.
- A9.2 Either of the methods of estimating the 'limit of detection' given may be used. The estimate of standard deviation used must be calculated from the initial performance testing data using ANOVA. An F-test may be used to determine whether a failure to achieve the target limit of detection is statistically significant.
- A9.3 'Precision' is twice the total within laboratory standard deviation. It must be calculated from the initial performance testing data using ANOVA. An F-test may be used to determine whether a failure to achieve the target precision is statistically significant.
- A9.4 'Trueness' must be determined using the calculated value of a standard solution or added spike as the true value, and the mean value calculated from the initial performance testing data using ANOVA. A t-test may be used to determine whether a failure to achieve the target trueness is statistically significant, provided precision is satisfactory.

## **A10 Use of Reporting Limits instead of the limit of detection**

- A10.1 Analytical reporting limits (RLs) are values or concentrations, other than limits of detection (LODs), that are used by laboratories, and sometimes Water Companies, as a cut off below which all results for a particular test are reported as being less than that value or concentration. They should not be used for parameters that are defined as the sum of the detected concentrations of the constituent compounds, eg total pesticides, trihalomethanes, polycyclic aromatic hydrocarbons.
- A10.2 RLs are sometimes used instead of the determined LODs because the LOD has a value or concentration that is not compatible with the laboratory's or company's policy on reporting results because it has more significant figures than are reported. This practice is only acceptable if the RL adopted is the LOD rounded up to the last reporting figure, and the RL is only applied to the final calculated result (including any conversion to regulatory units). Examples of acceptable and unacceptable RLs are given below.

### **Examples of inappropriate use of reporting limits**

LOD	Maximum permissible LOD	RL <sup>1,2</sup>	Reason given for adopting RL
0.31	2.5	2.5	Equals maximum permissible LOD and will not need revising if LOD changes
0.65	1	2	Set as a common RL for all determinands in the analysis suite

<sup>1</sup> Using these RLs on the public record instead of the actual result of analysis would contravene the reporting requirements.

<sup>2</sup> Applying these RLs to intermediate results (eg to nitrite and total oxidised nitrogen results before calculating the nitrate result) would contravene the requirements of regulation 16. The calculation is part of the analytical method.

### **Examples of appropriate use of reporting limits**

LOD	Number of decimal places reported for results close to the LOD <sup>3,4</sup>	Appropriate RL
0.141	3	0.141
0.141	2	0.15
0.141	1	0.2

<sup>3</sup> The number of decimal places reported should always be related to method performance.

<sup>4</sup> The examples of number of decimal places reported are given for demonstration of appropriate reporting limits only and do not reflect any view on the appropriate number of significant figures to report.

### **A11 Regulations 16(7) to 16(11)**

- A11.1 Where a method of analysis is specified in Table A1 in Schedule 4, the prescribed method, laboratories must use the specified method unless an alternative method has been authorised (approved), in which case the authorised alternative may be used subject to any conditions given in the authorisation. An alternative method may not be used until written authorisation has been given to the appropriate water company.
- A11.2 A laboratory wishing to use an alternative method that has not been approved must first make application, through the relevant water company, for authorisation of the method. Such application must be made in writing to the Drinking Water Inspectorate and must include a full description of the method to be used along with results of tests demonstrating both the reliability of the method and its equivalence to the prescribed method.
- A11.3 More detail of the information and testing requirements and criteria are given in 'The Microbiology of Drinking Water 2002. An expert group of microbiologists from member states is to be established to provide advice to the Commission on technical issues such as performance testing of alternative microbiological methods.
- A11.4 An alternative method will only be authorised if it is adequately documented and the results of tests demonstrate to the Drinking Water Inspectorate's satisfaction that results obtained using the method are at least as reliable as those produced by the use of the prescribed method.
- A11.5 The Drinking Water Inspectorate may make any authorisation subject to such conditions as it considers appropriate, eg limitation of the types of sample matrix it may be used to analyse or specify extra quality control requirements. Authorisation may be general or granted to a specific water company. It may also be revoked at any time, by notice in writing to any water company to which authorisation has been given. At least three months notice will be given of any revocation.

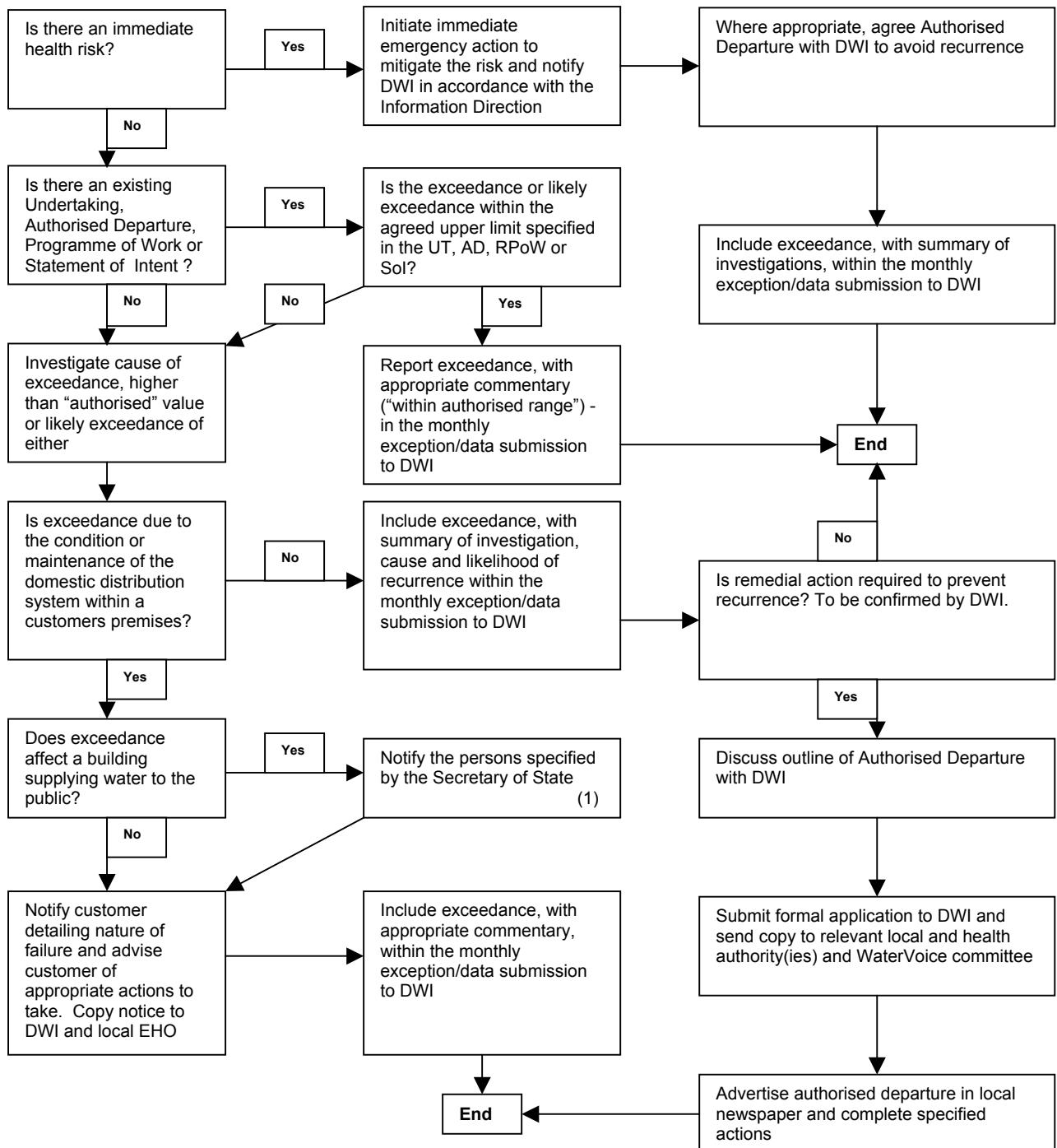
## A12 Additional Information

A12.1 In addition to the guidance given above and in the documents referenced in the Annex and the Introduction to the Guidance, advice on different aspects of AQC is given in a number of other documents, many of which are referenced within the reference documents. Further sources of relevant information are:

- 'Guidelines for Calibration in Laboratories', which is available on the DWI website ([www.dwi.gov.uk](http://www.dwi.gov.uk)).
- 'A Manual of Analytical Quality Control for the Water Industry'(NS30).
- Harmonised Guidelines for Internal Quality Control in Analytical Chemistry Laboratories ISO/IUPAC/AOAC, Pure and Applied Chemistry, vol 67, No 4, pp 649-666, 1995 (The AQC Guidelines).
- "Guidance On The Interpretation Of Aspects Of Analytical Quality Control (AQC)"
- "The International Harmonised Protocol for the Proficiency Testing of (Chemical) Analytical Laboratories" M Thompson, R Wood, Journal of AOAC International, Vol 76, No 4, 1993.
- "The Determination of Taste and Odour in Potable Waters 1994" in the series Methods for the Examination of Waters and Associated Materials (HMSO)
- "Quality Control Charts in Routine Analysis", Gardner M J, Water Research Centre, November 1996, WRc Ref: CO 4239
- BSi Draft for Development "Water Quality – Guide to analytical quality control for water analysis" BSi Ref: DD ENV ISO 13530:1999 (CEN Ref: ENV ISO 13530:1998 E. ISO Ref: ISO/TR 13530:1997(E)).
- "Quality Control Charts in Routine Analysis", Gardner M J, Water Research Centre, November 1996, WRc Ref: CO 4239.

## APPENDIX 2

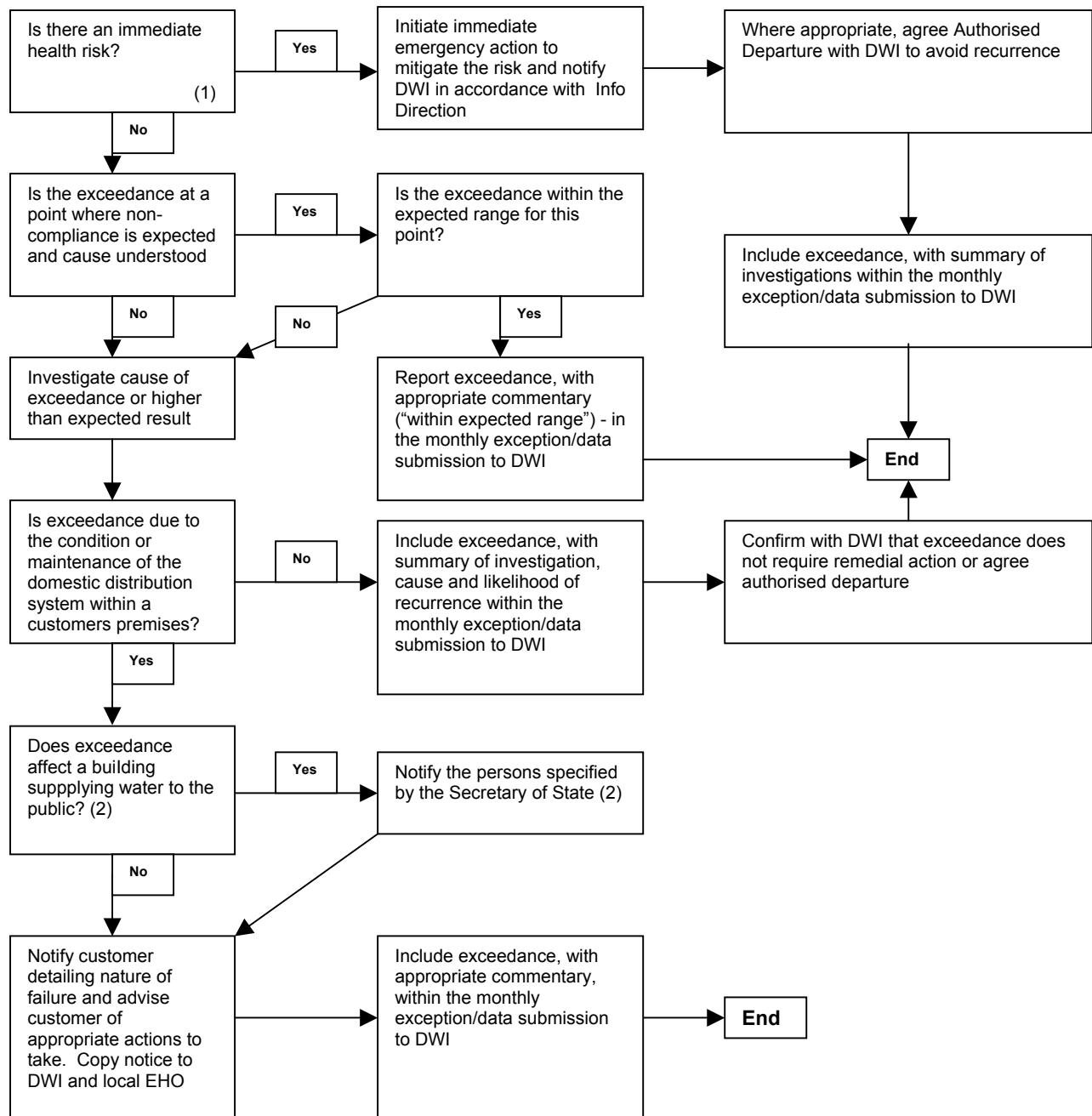
### PROCEDURE TO BE FOLLOWED IF MANDATORY PARAMETER FAILS OR IS LIKELY TO FAIL A PRESCRIBED CONCENTRATION OR VALUE



Note 1 Details to be confirmed when Regulations on the quality of water supplied to public buildings are in place.

## APPENDIX 3

### PROCEDURE TO BE FOLLOWED IF AN INDICATOR PARAMETER DOES NOT MEET A SPECIFICATION

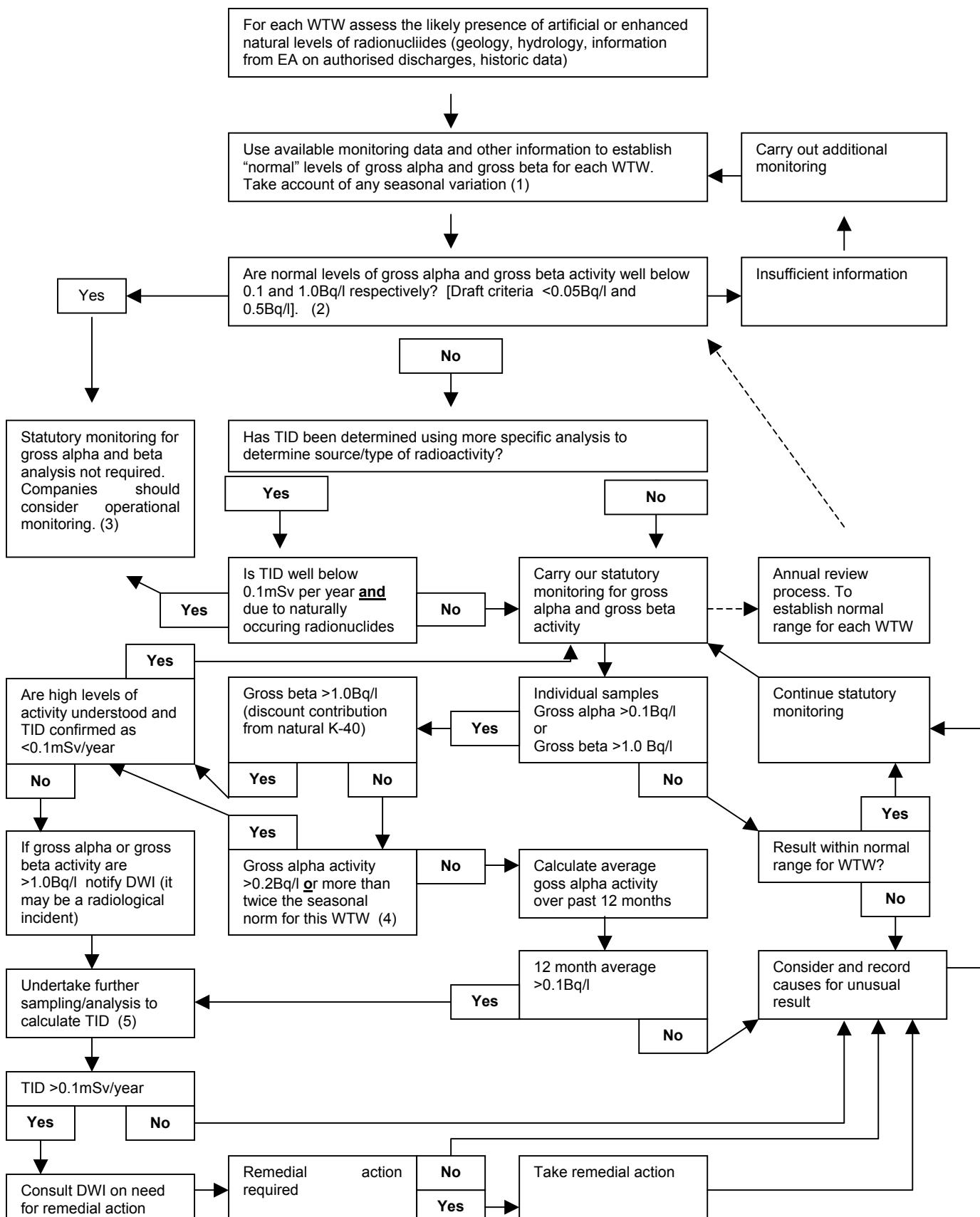


Note 1 An immediate health risk for an indicator parameter is unlikely but possible (eg very high levels of radioactivity)

Note 2 Details to be confirmed when Regulations on the quality of water supplied to public buildings are in place.

## APPENDIX 4

**APPENDIX I**  
**FLOW CHART FOR MONITORING OF GROSS ALPHA AND GROSS BETA ACTIVITY  
AND TOTAL INDICATIVE DOSE**



## **APPENDIX 4**

### **FLOW CHART FOR MONITORING OF GROSS ALPHA AND GROSS BETA ACTIVITY AND TOTAL INDICATIVE DOSE**

#### **Footnotes for the flowchart**

- (1) Seasonal increases in river flow may dilute any inputs of artificial radionuclides or those associated with water reuse (eg potassium-40) but flood conditions may encourage an increase in soil run-off and increase the input of some naturally occurring radionuclides.
- (2) Excluding tritium, potassium-40, radon and radon decay products
- (3) Radioactivity is now a feature of the drinking water regulations. Therefore it is prudent for water companies to carry out an operational monitoring programme to demonstrate that there have been no significant changes over time.
- (4) The use of 0.2Bq/l is a tentative proposal in recognition of the fact that the World Health Organisation is likely to increase its screening value for gross alpha activity (possibly to 0.5Bq/l). Using 0.2Bq/l will minimise the need for more detailed analysis on those supplies that show seasonal variations that take occasional samples just above 0.1Bq/l.
- (5) Further analysis should not necessarily involve comprehensive analysis for all radionuclides. In the first instance the presence of naturally occurring radionuclides such as uranium-238 or radium-226 should be considered. If these substances account for the vast majority of the recorded activity (ie the unaccounted for activity is <0.05Bq/l or 0.5Bq/l) then the Total Indicative Dose calculation should be based on these substances alone. It should be noted that ICP-MS methods can be used to give an initial and rapid indication of what substances might be contributing to the elevated levels of radioactivity.

**APPENDIX 5**  
**REPORT TO LOCAL AUTHORITIES (REGULATION 35)**

<b>LOCAL AUTHORITY REPORT</b>						
Reg	Information required					
35(4)(a)	<b>WATER TREATMENT WORKS</b>					
35(5)	For each WTW which supplies water to the LA area					
35(5)(a)	Names of water supply zones supplied from WTWs					
35(5)(b)	General requirement for provision of results					
35(5)(c)	Schedule 1 parameters	No. samples	No. samples >PCV	% >PCV	No. samples >Auth dep	% > Auth dep
	T Coliforms					
	E Coli					
	Nitrite					
35(5)(d)	Indicator parameters	No. samples	No. samples >specification	% >Spec		
	Colony counts					
	Turbidity					
	Residual chlorine (no. of samples - no spec or PCV)					
35(5)(e)	Schedule 1 parameters		Min	Mean	Max	
	Nitrite					
	<i>Cryptosporidium</i>					
	(not TC/EC)					
35(5)(f)	Indicator parameters		Min	Mean	Max	
	Residual chlorine					
	(not <i>Clostridium perfringens</i> )					
35(4)(b)	<b>SERVICE RESERVOIRS</b>					
35(6)	For each SR which supplies water to the LA area					
35(6)(a)	Names of water supply zones supplied from SRs					
35(6)(b)	General requirement for provision of results					
35(6)(c)	Schedule 1 parameters	No. samples	No. samples >PCV	% >PCV	No. samples >Auth dep	% > Auth dep
	Total Coliforms					
	<i>E Coli</i>					
35(6)(d)	Indicator parameters	No. samples	No. samples >specification	% >Spec		
	Colony counts					
	Residual chlorine (no. of samples - no spec or PCV)					
35(6)(e)	Schedule 1 parameters		Min	Mean	Max	
	(not Total Coliforms / <i>E. coli</i> )					

35(6)(e)	Indicator parameters		Min	Mean	Max	
	Residual chlorine					
	(not <i>Clostridium perfringens</i> )					
35(4)(b)	<b>SUPPLY POINTS</b>					
35(6)	For each Supply Point which supplies water to the LA area					
35(6)(a)	Names of Water Supply Zones supplied from Supply Points					
35(6)(c)	Schedule 1 parameters	No. samples	No. samples >specification	% >PCV	No. samples >Auth dep	% > Auth dep
	Benzene etc					
35(6)(d)	Indicator parameters	No. samples	No. samples >PCV	% >Spec		
	Chloride etc					
35(6)(e)	Schedule 1 parameters		Min	Mean	Max	
	Benzene etc					
35(6)(e)	Indicator parameters		Min	Mean	Max	
	Chloride etc					
	<b>WATER SUPPLY ZONES</b>					
35(7)	For each water supply zone which supplies water to the Local Authority					
35(7)(a)	The number of samples taken for each parameter					
35(7)(b)	General requirement for provision of results					
35(7)(c)	Schedule 1 parameters		No. samples >PCV	% >PCV	No. samples >Auth dep	% > Auth dep
	Enterococci					
	<i>E Coli</i>					
	Aluminium etc					
	Antimony etc					
35(7)(d)	Indicator parameters		No. samples >specification	% >Spec		
	Colony counts					
	Residual chlorine (no. of samples - no spec or PCV)					
	Ammonium etc					
35(7)(e)	Schedule 1 parameters		Min	Mean	Max	
	Aluminium etc					
	Antimony etc					
	(not Enterococci / <i>E. coli</i> )					
35(7)(f)	Indicator parameters		Min	Mean	Max	
	Residual chlorine					
	Ammonium etc					
	(not Total Coliforms / <i>Clostridium perfringens</i> )					

**APPENDIX 6**  
**ANNUAL WATER QUALITY REPORT (REGULATION 36)**

<b>WATER COMPANY ANNUAL WATER QUALITY REPORT</b>						
Reg	Information required					
36						
<b>WATER TREATMENT WORKS</b>						
36(1)(a)	No. of WTW, SR and supply points					
36(1)(b)	No. of water supply zones					
36(1)(c)	For all WTWs information in 36(4) (aggregated data)					
36(4)(a)	Total No. of samples (Each parameter, chlorine residual, <i>Cryptosporidium</i> )					
36(4)(b)	Schedule 1	No. Samples	No. samples > PCV	% >PCV	No. samples > Auth dep	% >Auth dep
	Total Coliforms					
	<i>E. coli</i>					
	Nitrite					
36(4)(c)	No. and % of WTW in which samples > PCV					
	No. and % of WTW in which samples > AD					
36(4)(d)	Indicator parameters	No. Samples	No. samples > specification	% >Spec		
	Colony Counts					
	Turbidity					
	<i>Cryptosporidium</i>					
36(4)(e)	No. and % of WTW in which samples > Specification					
<b>SERVICE RESERVOIRS</b>						
36(1)(d)	For all SRs (and supply points) information in 36(5) (aggregated data)					
36(5)(a)	Total No. of samples (Each parameter, chlorine residual)					
36(5)(b)	Schedule 1	No. Samples	No. samples > PCV	% >PCV	No. samples > Auth dep	% >Auth dep
	Total Coliforms					
	<i>E. coli</i>					
36(5)(c)	No. and % of SR in which samples > PCV					
	No. and % of SR in which samples > AD					
36(5)(d)	Indicator parameters	No. Samples	No. samples > specification	% >Spec		
	Colony Counts					
36(5)(e)	No. and % of SR in which samples > Spec					

	<b>SUPPLY POINTS</b>				
36(1)(a)	No. of supply points				
36(1)(d)	For all supply points information in 36(4) and 36(5) (aggregated data)				
36(5)(a)	Total No. of samples (Each parameter, chlorine residual)				
36(5)(b)	Schedule 1	No. Samples	No. samples > PCV	% >PCV	No. samples > Auth dep
	Benzene etc				
36(5)(c)	No. and % of supply points in which samples > PCV				
	No. and % of supply points in which samples > AD				
36(5)(d)	Indicator parameters		No. samples > specification	% >Spec	
	Chloride etc				
36(5)(e)	No. and % of supply points in which samples > Spec				
	<b>WATER SUPPLY ZONES</b>				
36(1)(e)	For all water supply zones information in 36(6) (aggregated data)				
36(6)(a)	The number of samples taken for each parameter				
36(6)(b)	Schedule 1		No. samples > PCV	% >PCV	No. samples > Auth dep
	Enterococci				
	<i>E coli</i>				
	Aluminium etc				
	Antimony etc				
36(6)(c)	No. and % of zones in which samples > PCV				
	No. and % of zones in which samples > AD				
36(6)(d)	Indicator		No. samples > specification	% >Spec	
	Colony Counts				
	Ammonium etc				
36(6)(e)	No. and % of zones in which samples > Spec				

## APPENDIX 7

<b>SUMMARY OF MONITORING REQUIREMENTS</b>											
Parameter	Unit	PCV (Specification for indicator parameters)	Point of monitoring	Check (high) monitoring	Audit (low) monitoring	Annual sampling frequency Water supply zones			Annual sampling frequency Water treatment works or supply points		
						Population	Reduced frequency range	Standard frequency range	Volume m <sup>3</sup> /d	Reduced frequency range	Standard frequency range
<b>Table A Microbiological parameters – Directive requirements</b>											
Enterococci	No/100 ml	0	T	X	Yes	Pop B	X	1-8	X	X	X
Escherichia coli	No/100 ml	0	T	Yes	X	<100	X	4	X	X	X
						>100	X	12 per each 5000	X	X	X
<b>Table A Microbiological parameters – National requirements</b>											
Coliform bacteria	No/100 ml	0	T + SR + WTW	Yes	X	<100	X	4	Vol C	12-104 <sup>(1)</sup>	4-365
						>100	X	12 per each 5000			
Escherichia coli	No/100 ml	0	SR + WTW	Yes	X	X	X	X	Vol C	12 - 104 <sup>(1)</sup>	4 - 365
Residual disinfectant	mg/l	X	T + SR + WTW + SP	X	Yes	<100	X	4	Vol C	12 - 104 <sup>(1)</sup>	4 - 365
						>100	X	12 per each 5000			

**Table B Chemical parameters – Directive requirements**

Parameter	Unit	PCV (Specification for indicator parameters)	Point of monitoring	Check (high) monitoring	Audit (low) monitoring	Annual sampling frequency Water supply zones			Annual sampling frequency Water treatment works or supply points		
						Population	Reduced frequency range	Standard frequency range	Volume m <sup>3</sup> /d	Reduced frequency range	Standard frequency range
Acrylamide	µg/l	0.1	PS	X	X	X	X	X	X	X	X
Antimony	µg Sb/l	5	T (or SP) <sup>(2)</sup>	X	Yes	Pop B	X	1-8	Vol E <sup>(2)</sup>	X	1-48
Arsenic	µg As/l	10	T (or SP) <sup>(2)</sup>	X	Yes	Pop B	X	1-8	Vol E <sup>(2)</sup>	X	1-48
Benzene	µg /l	1	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Benzo (a) pyrene	µg /l	0.01	T	X	Yes	Pop B	X	1-8	X	X	X
Boron	mgB/l	1	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Bromate <sup>(3)(4)</sup>	µg BrO <sub>3</sub> /l	10	T or SP	X	Yes <sup>(3)</sup>	Pop B <sup>(3)</sup>	X	1-8	Vol E <sup>(2)(4)</sup>	X	1-48
Cadmium	µg Cd/l	5	T (or SP) <sup>(2)</sup>	X	Yes	Pop B	X	1-8	Vol E <sup>(2)</sup>	X	1-48
Chromium	µg Cr/l	50	T	X	Yes	Pop B	X	1-8	X	X	X
Copper	mg Cu/l	2	T	X	Yes	Pop B	X	1-8	X	X	X
Cyanide	µg CN/l	50	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
1,2 Dichloroethane	µg/l	3	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Epichlorohydrin	µg/l	0.1	PS	X	X	X	X	X	X	X	X
Fluoride	mg F/l	1.5	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Lead <sup>(5)</sup>	µg Pb/l	25	T	X	Yes	Pop B	X	1-8	X	X	X
Lead <sup>(6)</sup>	µg Pb/l	10	T	X	Yes	Pop B	X	1-8	X	X	X
Mercury	µg Hg/l	1	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Nickel	µg Ni/l	20	T	X	Yes	Pop B	X	1-8	X	X	X

Parameter	Unit	PCV (Specification for indicator parameters)	Point of monitoring	Check (high) monitoring	Audit (low) monitoring	Annual sampling frequency Water supply zones			Annual sampling frequency Water treatment works or supply points		
						Population	Reduced frequency range	Standard frequency range	Volume m <sup>3</sup> /d	Reduced frequency range	Standard frequency range
<b>Table B Chemical parameters – Directive requirements (continued)</b>											
Nitrate <sup>(7)</sup>	mg NO <sub>3</sub> /l	50	T (or SP) <sup>(2)</sup>	Yes <sup>(7)</sup>	Yes	Check <sup>(7)</sup> Pop A	1 - 38	2 - 76	X	X	X
						Audit Pop B	X	1 - 8	X	X	X
Nitrite <sup>(8)</sup>	mg NO <sub>2</sub> /l	0.5	T	Yes <sup>(8)</sup>	Yes	Check Pop A	1 - 38	2 - 76	X	X	X
						Audit Pop B	X	1 - 8	X	X	X
Nitrite <sup>(8)</sup>	mg NO <sub>2</sub> /l	0.1	WTW	Yes <sup>(8)</sup>	Yes	X	X	X	Check Vol C <sup>(8)</sup>	12 - 104 <sup>(1)</sup>	4 - 365
									Audit Vol E	X	1 - 48
Aldrin	µg/l	0.03	T or SP	X	Yes	Pop B <sup>(12)</sup>	X	1-8	Vol E <sup>(12)</sup>	X	1 - 48
Dieldrin	µg/l	0.03	T or SP	X	Yes	Pop B <sup>(12)</sup>	X	1-8	Vol E <sup>(12)</sup>	X	1 - 48
Heptachlor	µg/l	0.03	T or SP	X	Yes	Pop B <sup>(12)</sup>	X	1-8	Vol E <sup>(12)</sup>	X	1 - 48
Heptachlor epoxide	µg/l	0.03	T or SP	X	Yes	Pop B <sup>(12)</sup>	X	1-8	Vol E <sup>(12)</sup>	X	1 - 48
Other individual pesticides	µg/l	0.1	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1 - 48
Total pesticides	µg/l	0.5	T or SP	X	Yes	Pop B	X	1-8	Vol E <sup>(2)</sup>	X	1 - 48
PAH	µg/l	0.1	T	X	Yes	Pop B	X	1-8	X	X	X
Selenium	µg Se/l	10	T (or SP) <sup>(2)</sup>	X	Yes	Pop B	X	1-8	Vol E <sup>(2)</sup>	X	1-48
Tetrachloroethane	} µg/l	} 10	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Trichloroethane											
Trihalomethanes	µg/l	100	T (or SP) <sup>(2)</sup>	x	Yes	Pop B	X	1-8	Vol E <sup>(2)</sup>	X	1-48
Vinyl chloride	µg/l	0.5	PS	X	X	X	X	X	X	X	X

Parameter	Unit	PCV (Specification for indicator parameters)	Point of monitoring	Check (high) monitoring	Audit (low) monitoring	Annual sampling frequency Water supply zones			Annual sampling frequency Water treatment works or supply points		
						Population	Reduced frequency range	Standard frequency range	Volume m <sup>3</sup> /d	Reduced frequency range	Standard frequency range

**Table B Chemical parameters – National requirements**

Aluminium <sup>(10)</sup>	µg Al/l	200	T	Yes <sup>(10)</sup>	Yes	Check <sup>(10)</sup> Pop A	1-38	2-76	X	X	X
						Audit Pop B	X	1 - 8	X	X	X
Colour	mg/l Pt/Co	20	T	Yes	X	Pop A	1-38	2-76	X	X	X
Hydrogen ion	pH value	6.5 – 10	T	Yes	X	Pop A	1-38	2-76	X	X	X
Iron <sup>(10)</sup>	µg Fe/l	200	T	Yes <sup>(10)</sup>	Yes	Check <sup>(10)</sup> Pop A	1-38	2-76	X	X	X
						Audit Pop B	X	1 - 8	X	X	X
Manganese <sup>(11)</sup>	µg Mn/l	50	T	Yes <sup>(11)</sup>	Yes	Check <sup>(11)</sup> Pop A	1-38	2-76	X	X	X
						Audit Pop B	X	1 - 8	X	X	X
Odour	Dilution number	3	T	Yes	X	Pop A	1-38	2-76	X	X	X
Sodium	µg Na/l	200	T	X	Yes	Pop B	X	1-8	X	X	X
Taste	Dilution number	3	T	Yes	X	Pop A	1-38	2-76	X	X	X
Tetrachloromethane	µg/l	3	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1 - 48
Turbidity	NTU	4	T	Yes	X	Pop A	1-38	2-76	X	X	X

Parameter	Unit	Specification for indicator parameters	Point of monitoring	Check (high) monitoring	Audit (low) monitoring	Annual sampling frequency Water supply zones			Annual sampling frequency Water treatment works or supply points		
						Population	Reduced frequency range	Standard frequency range	Volume m <sup>3</sup> /d	Reduced frequency range	Standard frequency range
<b>Schedule 2 – Indicator parameters</b>											
Ammonium	mg NH <sub>4</sub> /l	0.5	T	Yes	X	Pop A	1-38	2-76	X	X	X
Chloride	mg Cl/l	250	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
<i>Clostridium perfringens</i> <sup>(9)</sup>	No/100 ml	0	T + WTW <sup>(9)</sup>	Yes <sup>(9)</sup>	Yes	Check Pop A	1-38	2-76	Check Vol D <sup>(9)</sup>	2-1095 <sup>(1)</sup>	2-2190
						Audit Pop B	X	1 - 8	Audit Vol E	X	1 - 48
Colony counts	Number / 1 ml 22°C Number / 1 ml 37°C	NAC	T + SR + WTW	Yes	X	Pop A	1-38	2-76	Vol C	12-104 <sup>(1)</sup>	4-365
Conductivity	µS/cm at 20°C	2500	T or SP	Yes	X	Pop A	1-38	2-76	Vol E	X	1-48
Sulphate	µg SO <sub>4</sub> /l	250	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Total indicative dose <sup>(13)</sup>	mSv/year	0.1	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Total organic carbon	mg C/l	NAC	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Tritium <sup>(13)</sup>	Bq/l	100	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Turbidity	NTU	1	WTW	X	X	X	X	X	Vol C	12-104 <sup>(1)</sup>	4-365
<b>Others</b>											
Nitrate / nitrite formula	mg/l	NO <sub>3</sub> /50 + NO <sub>2</sub> /3 =<1	T	X	Yes	Calculate from above sample results	X	X	X	X	X
<b>NOTES</b>											
X = Not applicable; NAC = No abnormal change; PS = Product specification; SP = Supply point; SR = Service reservoir; T = Consumers' taps in WSZ; WTW = Water treatment works; WSZ = Water supply zone											
<sup>(1)</sup> Reduced frequency not available if <20m <sup>3</sup> /d water supplied											
<sup>(2)</sup> Supply point monitoring only if authorised by the Secretary of State under regulation 8											
<sup>(3)</sup> Audit monitoring in WSZ is required only where sodium hypochlorite is added after water has left the WTW											
<sup>(4)</sup> Audit monitoring at SP is required only when sodium hypochlorite is not added after water has left the WTW											
<sup>(5)</sup> Prescribed concentration applies from 25 December 2003 until 24 December 2013											
<sup>(6)</sup> Prescribed concentration applies on and after 25 December 2013											
<sup>(7)</sup> Check monitoring in WSZ is required only where chloramination is practised.											
<sup>(8)</sup> Check monitoring is required only when chloramination is practised											
<sup>(9)</sup> Check monitoring is required only in respect of surface waters (see regulation 6(2) and Table 1 in Schedule 3)											
<sup>(10)</sup> Check monitoring is required when used as a flocculant or where the water originates from, or is influenced by, surface water											
<sup>(11)</sup> Check monitoring is required where the water originates from, or is influenced by, surface waters											
<sup>(12)</sup> If required by pesticide monitoring strategy						<sup>(13)</sup> If required by radioactivity monitoring strategy					

<b>SAMPLING FREQUENCIES</b>										
<b>Population A (Check) zones</b>	<100	100 – 4999	5000 - 9999	10,000 – 29,999	30,000 – 49,999	50,000 - 79,999	80,000 – 100,000			
Reduced frequency	1	2	6	12	18	26	38			
Standard frequency	2	4	12	24	36	52	76			
<b>Population B (Audit) zones</b>	<100	100 - 4999	5000 – 100,000							
Reduced frequency	N/A	N/A	N/A							
Standard frequency	1	4	8							
<b>Volume C (Check) WTW (m<sup>3</sup>/day)</b>	<20	20 – 1999	2000 – 5999	6000 – 11,999	>12,000					
Reduced frequency	N/A	12	52	104	104					
Standard frequency	4	52	104	208	365					
<b>Volume D (Check) Supply points (m<sup>3</sup>/day)</b>	<20	20 – 999	1000 – 1999	2000 – 5999	5000 – 9999	10,000 – 15,999	16,000 – 32,999	33,000 – 49,999	50,000 – 67,999	68,000 – 84,999
Reduced frequency	N/A	2	6	12	18	26	52	78	104	130
Standard frequency	2	4	12	24	36	52	104	156	208	260
<b>Volume D (Check) Supply points (m<sup>3</sup>/day) continued</b>	85,000 – 101,999	102,000- 119,999	120,000 – 241,999	242,000 – 484,999	485,000 – 728,999					
Reduced frequency	156	183	365	730	1095					
Standard frequency	312	365	730	1460	2190					
<b>Volume E (Audit) Supply points (m<sup>3</sup>/day)</b>	<20	20 – 999	1000 – 49,999	50,000 – 89,999	90,000 – 299,999	300,000 – 649,999	>650,000			
Reduced frequency	N/A	N/A	N/A	N/A	N/A	N/A	N/A			
Standard frequency	1	4	8	12	24	36	48			
<b>Sampling frequency for all service reservoirs</b> - one sample for each week in which the reservoir is in use										